MATHEMATICS DEPARTMENT
VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M.Sc. (Mathematics)

Scheme of Teaching and Examination

Semester – I

Subject Code	Subject	Scheme Of Teaching			Scheme Of Examination					
		L	P	Total	Th.		Pr.		Total	
					Int	ext	Int	Ext	Int	Ext
401	Measure Theory	4	--	4	30	70	--	--	30	70
402	Complex Analysis	4	--	4	30	70	--	--	30	70
403	Topology	4	--	4	30	70	--	--	30	70
404	Ordinary Differential Equations	4	--	4	30	70	--	--	30	70
405	Graph Theory	4	--	4	30	70	--	--	30	70
406	Fourier Analysis	4	--	4	30	70	--	--	30	70
	Total	24	--	24	180	420	--	--	180	420

Semester – II

Subject Code	Subject	Scheme Of Teaching			Scheme Of Examination					
		L	P	Total	Th.		Pr.		Total	
					Int	ext	Int	Ext	Int	Ext
501	Differential Geometry	4	--	4	30	70	--	--	30	70
502	Functional Analysis	4	--	4	30	70	--	--	30	70
503	Elements of Partial Differential Equations	4	--	4	30	70	--	--	30	70
504	Discrete Structure	4	--	4	30	70	--	--	30	70
505	Numerical Analysis	4	--	4	30	70	--	--	30	70
506	Functions of Complex Variables	4	--	4	30	70	--	--	30	70
	Total	24	--	24	180	420	--	--	180	420

Semester – III

Subject Code	Subject	Scheme Of Teaching			Scheme Of Examination					
		L	P	Total	Th.		Pr.		Total	
					Int	ext	Int	Ext	Int	Ext
601	Abstract Algebra	4	--	4	30	70	--	--	30	70
602	Advanced Functional Analysis	4	--	4	30	70	--	--	30	70
603	Linear Algebra	4	--	4	30	70	--	--	30	70
604	Advance Numerical Analysis	4	--	4	30	70	--	--	30	70
600X	Elective Group	4	--	4	30	70	--	--	30	70
600X (*)		4	--	4	30	70	--	--	30	70
600X		4	--	4	30	70	--	--	30	70
	Total	24	--	24	180	420	--	--	180	420

Elective group -1	6001	Fluid Dynamics
	6002*	Mathematical Software
Elective group -2	6003	Mechanics
	6004	Combinatorics
Elective group -3	6005	Linear programming
	6006	Operation Research
Elective group - 4	6007	Integral Transforms-I
	6008	Advanced Integral Transform-I
Elective group - 5	6009	Elementary Number Theory
	6010	Algebraic Number Theory
Elective group - 6	6011	Special Functions - I
	6012	Special Functions - II
Elective group - 7	6013	Neural Network
	6014	Fuzzy Modeling

Note: (*) paper no – 6002 scheme of teaching L – 4 T – 1 P – 4

Examination scheme for Theory: 18 (internal) 42(external)

Practical: 12 (internal) 28(external)

Total: 30 (internal) 70(external)

Semester – IV

Subject Code	Subject	Scheme Of Teaching			Scheme Of Examination					
		L	P	Total	Th.		Pr.		Total	
					Int	ext	Int	Ext	Int	Ext
701	Advanced Abstract Algebra	4	--	4	30	70	--	--	30	70
702	Theory of Operators	4	--	4	30	70	--	--	30	70
703	Advanced Topology	4	--	4	30	70	--	--	30	70
704	Advanced Ordinary Differential Equations	4	--	4	30	70	--	--	30	70
700X	Elective Group	4	4	8	18	42	12	28	30	70
700X		4	--	4	30	70	--	--	30	70
700X		4	4	8	18	42	12	28	30	70
	Total	24	8	32	156	364	24	56	180	420

Elective group -1	7001	Computational Fluid Dynamics
	7002	Mathematical Modeling
Elective group -2	7003	Finite Element Method
	7004	Wavelet Analysis
Elective group -3	7005	Non - Linear Programming
	7006	Advanced Operational Research
Elective group - 4	7007	Integral Transforms-II
	7008	Advanced Integral Transform-II
Elective group - 5	7009	Advance Number Theory
	7010	Analytic Number Theory
Elective group - 6	7011	Special Functions - III
	7012	Special Functions - IV
Elective group - 7	7013	Digital Signal Processing
	7014	Image Processing

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Syllabus to be offered at M. Sc. Part-I Semester - I w.e.f. June 2010-11

Paper: 401
Measure Theory

L T P
4-1-0

Prerequisite
The extended real numbers, Borel sets.

Lebesgue measure

Introduction, outer measure, measurable sets and Lebesgue measure, A non measurable sets, measurable function, Littlewoods's three principles.

Lebesgue integral
The Riemann integral, The Lebesgue integral of a bounded function over a set of finite measure, The integral of a non negative function, The general Lebesgue integral, Lebesgue convergence theorem, monotone convergence theorem, Fatau's lemma, generalized Lebesgue convergence theorem

Differentiation and integration

Differentiation of monotone functions, and functions of a bounded variation. Differentiation of an integral, absolute continuity, convex functions.

References:

1. H. L. Royden, Real Analysis, Macmillan publication, 1993.
2. Walter Rudin, Principles of mathematical analysis, McGraw Hill, 1976.
3. T. M Apostol, Mathematical Analysis, Narosa publishing house, 1985.
4. G.de. Barra, Measure theory and Integration, Wiley Eastern limited 1981.
5. I. P. Natanson, Theory of Functions of real variable, Fredrick Unger pub.1961.

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Syllabus to be offered at M. Sc. Part-I Semester - I w.e.f. June 2010-11

Paper: 402
Complex Analysis

L T P
4-1-0

Complex Numbers:

Definition of Complex Numbers, Square roots, Geometric interpolation, rational powers of a Complex Numbers, Topology of the complex plane, Sequence **and** series.

Analytic Functions:

Functions, limits and continuity, differentiability Power series as an analytic function, Exponential and Trigonometric functions, Complex logarithms, Inverse functions, Zeros of analytic functions.

Complex Integration:

Curves in the complex plane, Basic properties of complex Integral, winding number or index of a curve, Cauchy-Gaursat Theorem, Homotopy version of Cauchy's theorem, Morea's theorem, Cauchy Integral Formula, Laurent series, The maximum modulus principle.

References:

1. S. Ponnuswamy, foundation of complex analysis, Narosa publishing house, 1997.
2. S. Lang, Complex Analysis, Addition Wesley, 1997.
3. J. N. Sharma, Functions of a Complex Variable, Krishna Prakashan, 2000.
4. H. A. priestly, introduction to complex analysis, Clarendon Press, 1990.
5. J. B. Conway, Functions of one complex variable, Springer- Verlag, 1980.

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Syllabus to be offered at M. Sc. Part-I Semester - I w.e.f. June 2010-11

Paper: 403
Topology

L T P
4-1-0

I. Fast Revision:

- Sets and functions
- Metric Spaces: Definitions and examples

II. Topological Spaces:

Definitions :

- Topological Space and examples.
- Relative Topology and Examples,
- Continuity & Convergence

Elementary Concepts:

- Open and Closed sets with examples,
- Closure of a set
- Neighborhood of a point, Interior point, limit point, Derived set with theorems and examples

Open Base and Open sub-base:

- Definition and Examples,
- First and second countable spaces with theorems and examples
- Separable spaces with theorems and examples

III. Compactness:

Definitions :

- Cover, Sub-cover, open cover, Basic and sub-basic open cover, sub-cover, countable open cover,
- Continuity and Compactness, with theorems and examples,
- Finite intersection property,
- Heine Borel property with theorems.

Product Spaces:

- Definition and examples,
- Projection mappings and its continuity,
- Open and closed sub-base for product space

Tychonoff's Theorem and Locally Compact Spaces:

- Tychonoff's theorem
- Generalized Heine Borel theorem

Compactness for Metric Spaces:

- Sequentially Compact Metric Space,
- Bolzano Weierstrss Property (BWP),
- Totally bounded Space,
- Ascoli's theorem,

References:

1. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Co., 1963.
2. James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
3. J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice Hall of India Pvt. Ltd.).
4. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.
5. J. Hocking and G. Young, Topology, Addison-Wesley, Reading, 1961.

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Syllabus to be offered at M. Sc. Part-I Semester - I w.e.f. June 2010-11

Paper :404
Ordinary Differential Equations

L T P
4-1-0

Existence Uniqueness and Continuation of Solutions:

Introduction, Notation and Definitions, Existence and Uniqueness of Solutions of Scalar Differential Equations: General solutions, solution of IVP, Lipschitz condition, Lipschitz constant, Peano's existence theorem, equicontinuous family of functions, Maximal and Minimal solutions, continuation of solution, Differential and Integral Inequalities. Existence Theorems for System of Differential Equations: Lipschitz constant for System of Differential Equations, Picard-Lindelof theorem, Peano's existence theorem, Differential and Integral Inequalities.

Linear Systems:

Introduction: Preliminaries and basic results, construction of T and T'AT, Properties of Linear Homogeneous Systems: Definitions, corollary, Able-Liouville formula, Adjoint systems, Periodic Linear Systems, Floquet's theorem, monodromy matrix, characteristic multipliers, characteristic exponents, Mathieu equation, Application-1 nth Order Linear Homogeneous Equation with variable coefficients, Application-2 nth Order Linear Homogeneous Equation with constant coefficients, Inhomogeneous Linear Systems: Application-1 nth Order Linear Non-homogeneous Equation with variable coefficients, Application-2 nth Order Linear Non-homogeneous Equation with constant coefficients, Behavior of Solutions of nth Order Linear Homogeneous Equations. Asymptotic Behavior.

References:

[1] Shair Ahmad and M Rama Mohan Rao, Theory of Ordinary Differential Equations Affiliated East-West Press Pvt. Ltd., New Delhi, 1999.

[2] P. Hartman, Ordinary Differential Equations, John Wiley, 1964.

[3] W. T. Reid, Ordinary Differential Equations, John Wiley, New York, 1971.

[4] E. A. Coddington and N. Levinson, Theory of Ordinary Differential Equations, Mc-Graw Hill, NY, 1955.

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Syllabus to be offered at M. Sc. Part-I Semester - I w.e.f. June 2010-11

Paper :405
Graph Theory

L T P
4-1-0

Graph-Paths-Circuits

What is Graph?, Application of Graphs, Finite and Infinite Graphs, Incidence and Degree, Isolated Vertex, Pendent Vertex, and Null Graph, Isomorphism, Subgraphs, Walks Paths, and Circuits, Connected Graphs, Disconnected Graphs, and Components, Euler Graphs, Operations on Graphs, More on Euler Graphs, Hamiltonian Paths and Circuits, The Traveling Salesman Problems.

Trees and Fundamentals Circuits :

Trees, Some Properties of Trees, Pendant vertices in a tree, Distance and Centers in a tree, Rooted and Binary Trees, On counting trees, Spanning trees, Fundamentals circuits, Finding all spanning Trees of a Graph, Spanning Trees in a Weighted Graph.

Cut-Sets and Cut-Vertices and Planar and Dual Graphs :

Cut-Sets, Some Properties of a Cut-Set, All Cut-Sets in a Graph, Fundamental Circuits and Cut-Sets, Connectivity and Separability, Planar Graphs, Kuratowski's Two Graphs, Different Representations of a Planar Graph, Detection of Planarity.

Matrix Representation of Graphs :

Incidence matrix, Submatrices of *A(G)*, Circuits Matrix, Fundamental Circuit Matrix and Rank of *B*, An Application to a Switching Network, Cut-Set Matrix, Relationships among A_f, B_f, and C_f, Path Matrix, Adjacency Matrix.

References:

1. Narsing Deo : Graph Theory, PHI, 1993.
2. B. Stayanarayan And K.S.Prasad : Discrete Mathematics & Graph Theory, PHI, (2009)
3. R. Manohar & Trembtey J.P. : Discrete Mathematical Structure with application to computer science, TMH, 1999
4. Wilson R.J. : Introduction to G.T. (3rd ed.) Longmann, 1984
5. Gibbons A. : Algorithnmic Graph Thepry, Cambridge University Press, 1984
6. Harry F. : Graph Theory, Narosa Publication, 1995
7. Richard J. : Discrete Mathematics, Pearson Educations, Asia, 2001

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Syllabus to be offered at M. Sc. Part-I Semester - I w.e.f. June 2010-11

Paper :406
Fourier Analysis

L T P
4-1-0

- Periodic Functions. Trigonometric Series.
- Computation of Fourier series, in various Interval.
- Convergence Theorems for Fourier series.
- Uniform Convergence of Fourier series.
- Functions of any Period $p = 2L$.
- Even and Odd Functions. Half-Range Expansions.
- Complex Fourier series.
- Forced Oscillations.
- Approximation by Trigonometric Polynomial.
- Fourier Integrals.
- Fourier cosine and Sine Transforms.
- Modeling: Vibrating String. Wave Equations.
- Separation of Variables. Use of Fourier Series.

References:

1. **Kreyszig** : Advanced engineering Mathematics, John Wiley & Sons, 1999
2. **Albert Boggess and Francis j. Narcowich** : A First Course in Wavelets with Fourier Analysis 2nd ed., WileyPublication, 2009.
3. **Jain, Iyenger** : Advanced Engineering mathematics, Wiley India.
4. **Carslaw** : Introduction to Fourier series & Fourier Integrals, CRC Press.

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Syllabus to be offered at M. Sc. Part-I Semester - II w.e.f. June 2010-11

Paper :501
Differential Geometry

L T P
4-1-0

Curves with Torsion:

Tangent, Principal Normal. Curvature, Binormal Torsion Serret-Frenet formulae, Helices, Spherical indicatrix of tangent, etc., Involutes, Evolutes, Bertrand curves,

Envelops Developable Surfaces:

Surfaces, Tangent Plane Normal, Envelope Characteristics, Edge of regression, Developable Surfaces, Osculating developable, Envelope Characteristic points,

Curvilinear Coordinates

Curvilinear coordinates, First order magnitudes, Directions on a surface, The normal, Second order magnitudes, Derivatives of **n**, Curvature of normal section. Meunier's theorem.

References:

1. Whetherburn C.E. : "Differential Geometry of 3-D", Radha Publishing, Calcutta. 1988
2. Bansilal : "Differential Geometry, 1994 Atma Ram and sons, Allahabad. 1994
3. S.C. Mittal and D. C. Agrawal : Differential Geometry, Krishna Publication, 1976
4. S. Kumaresan : A Course in Differential Geometry and Lie Groups Hindustan Book Agency, 2002
5. Sinha B.B. : An Introduction to Modern Differential geometry, Kalyani Publishers, New Delhi, 1982

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Syllabus to be offered at M. Sc. Part-I Semester - II w.e.f. June 2010-11

Paper :502
Functional Analysis

L T P
4 - 1 - 0

Metric space:

Metric space, Examples of Metric Space, Completion of metric space.

Normed Spaces and Banach Spaces

Vector Space, Normed Space, Banach Space, Further properties of Normed spaces, Finite Dimensional normed space and subspaces, Compactness and finite dimension, Linear operators, Bounded and continuous liner operators, Linear functional, Linear operators, Bounded and Continuous Linear Operators, Linear functional Linear Operators and Linear functional on a Finite dimensional spaces, Normed spaces of operators, Dual spaces

Inner Product Spaces, Hilbert Spaces

Inner Product space, Hilbert space, Properties of Inner product Space, Orthogonal compliments and direct sums, Orthonormal sets and sequences, Series related to Orthonormal sequences and sets'

References:

1. E. Kreyszig: Functional Analysis and its application, John Wiley and sons.
2. B.V. Limaye: Functional Analysis, Wiley Eastern Ltd.
3. G.F. Simmons: Introduction to Topology and Modern Analysis, McGraw - Hill.
4. J.N. Sharma & A Vashistha: Functional Analysis.

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Syllabus to be offered at M. Sc. Part-I Semester - II w.e.f. June 2010-11

Paper :503
Elements of Partial Differential Equations

L T P
4 - 1 - 0

Ordinary Differential Equations in More than Two Variables...

Surfaces and Curves in Three Dimensions, Simultaneous Differential Equations of the First Order and the Degree in Three Variables, Methods of Solutions of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, Orthogonal Trajectories of a Systems of a Curves on a Surface, Pfaffian Differential Forms and Equations, Solution of Pfaffian Differential Equations in Three Variables

Partial Differential Equations of the First Order

Partial Differential Equations, Origins of First-Order Partial Differential Equations, Linear Equations of the First Order, Integral Surfaces Passing through a Given Curve, Surfaces Orthogonal to a Given System of Surfaces, Nonlinear Partial Differential Equations of the First Order, Compatible Systems of First-order Equations, Charpit's Method, Special Types of First-order Equations, Solutions Satisfying Given Conditions, Jacobi's Method,

Partial Differential Equations of the Second Order

Linear Partial Differential Equations with Constant Coefficients, Equations with Variable Coefficients, Separation of Variables, Nonlinear Equations of the Second Order.

References:

1. Sneddon I.A. : Elements of Partial Differential Equations, McGraw Hill, Intonation Edition, 1957
2. Zafar Hasan : Differential Equations and their applications, Second Edition, PHI, 2009.
3. Iyengar S.N. :Differential Equations, Anmol Publications, 2000
4. Sharma Gupta : Differential Equations, Krishna Prakashan Media, 1997- 98.
5. Copson E.T. : Partial Differential Equations, S.-Chand & Co. Pvt. Ltd., 1976

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Syllabus to be offered at M. Sc. Part-I Semester - II w.e.f. June 2010-11

Paper :504
Discrete Structure

L T P
4-1-0

Algebraic Structures:

Algebraic systems, Examples and General Properties, Definition and Examples, Some Simple Algebraic Systems and General Properties, Semigroups and Monoids, Definitions and Examples, Homomorphism of Semigroups and Monoids, Subsemigroups and Submonoids, Grammars and Languages, Discussion of Grammars, Formal Definition of a Language, Notions of Syntax Analysis, Polish Expression and Their Compilation, Polish Notation, Conversion of Infix Expression to Polish Notation, The Application of Residue Arithmetic to Computers, Introduction to Number Systems, Residue Arithmetic, Group Codes, The Communication Model and Basic Notions Error Correction, Generation of Codes by Using parity Checks, Error Recovery in Group Codes,

Lattices and Boolean Algebra:

Lattices as Partially Ordered Sets, Definition and Examples, Some Properties of Lattices, Lattices as Algebraic Systems, Sublattices, Direct Product, and Homomorphism, Some Special Lattices, Boolean Algebra, Definition and Examples, Subalgebra, Direct Product, and Homomorphism , Boolean Functions, Boolean Forms and Free Boolean Algebras, Values of Boolean Expressions and Boolean Functions, Representation and Minimization of Boolean Functions, , Representation of Boolean Functions, Minimization of Boolean Functions, Design Examples Using Boolean Algebra, Finite-state Machines, Introductory Sequential Circuits, Equivalence of Finite-state Machines.

References:

1. Tremblay and Manohar : Discrete Mathematics Structures with Applications to Computer Science, Tata McGraw-Hill, 2008
2. Abbott J.C. : Sets, Lattices and Boolean Algebras, Allyn and Bacon, inc. Boston, 1969
3. Gibbons A. : Algorithmic Graph Theory, Cambridge Uni. Press, 1984.
4. Harary F. : Graph Theory, Narosa Publication, 1995.
5. Hohn F. : Applied Boolean Algebra (2^{nd} ed.), Macmillan, New York, 1966.
6. Liu C.L. : Elements of Discrete Mathematics, McGraw-Hill Inc., USA, 1985.
7. Richard Johnsonbaugh : Discrete Mathematics, Pearson Edu. Asia, 2001.
8. Rosen K.H. : Handbook of Discrete and Combinatorial Mathematics, CRC Press, 1999.

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Syllabus to be offered at M. Sc. Part-I Semester - II w.e.f. June 2010-11

Paper :505
Numerical Analysis

L T P
4-1-0

- **Transcendental and polynomial Equations :**
  Introduction
  Bisection Method
  Iteration Method base on first degree equation
  Iteration methods based on second degree equation
  Rate of convergence
  Iteration methods
  Method for complex roots
  Polynomial equations, model problems

- **System of Linear algebraic equations and Eigenvalue problems**
  Introduction
  Direct methods
  Iteration methods
  Eigenvalues and Eigenvectors
  Model problems

- **Interpolation and Approximation**
  Introduction
  Lagrange and Newton Interpolations
  Finite Difference operators
  Interpolating Polynomials using finite differences
  Model problems

References:

1. Jain, Iyenger & Jain : Numerical Methods, for Scientific and Engineering Computation, New-Age International. 1999

2. Froberg C. E. : Introduction to Numerical Analysis, Addison-Wesley, 1970

3. Philips and Taylor :Theory and Applications of Numerical Analysis Academic Press,1996

4. Gourdin and Boumhart :Applied Numerical Analysis, P.H.I., 1996

5. Householder A. S. :Theory of Matrices in Numerical Analysis, Blarsedell - New York.

6. Jacques and Colin : Numerical Analysis, Chapman & Hall, New-York, 1987

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Syllabus to be offered at M. Sc. Part-I Semester - II w.e.f. June 2010-11

Paper: 506
Functions of Complex Variables

L T P
4-1-0

Singularities:

Isolated and non-isolated singularities, removable singularities poles, singularities at infinity, Analytic continuations.

Calculus of Residues:

Residue at a finite point, residue at a point at infinity, residue theorem, no of zeros and poles, Roaches' theorem,

Residues and evaluation of certain integrals:

Integrals of type $\int_a^{2\pi+a} R(\cos\theta, \sin\theta)d\theta$ integrals of type $\int_{-\infty}^{\infty} f(x)dx$ integrals of type $\int_{-\infty}^{\infty} g(x)\cos(mx)dx$ singularity in real axes, more on using rectangular curves.

References:

1. S. Ponnuswamy, foundation of complex analysis, Narosa publishing house, 1997.
2. S. Lang, Complex Analysis, Addition Wesley, 1997.
3. J. N. Sharma, Functions of a Complex Variable, Krishna Prakashan, 2000.
4. H. A. priestly, introduction to complex analysis, Clarendon Press, 1990.
5. J. B. Conway, Functions of one complex variable, Springer- Verlag, 1980.

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Syllabus to be offered at M. Sc. Part-II Semester -III w.e.f. June 2011-12

Paper : 601
Abstract Algebra

L T P
4-1-0

Group Theory:

Conjugate of an element, class equation, and Cauchy theorem, First part of Sylow's theorem, Third part of Sylow's theorem, Application of Sylow's theorem, and direct product of a group.

Ring Theory:

A particular Euclidean ring, Fermat's theorem, polynomial rings, primitive polynomials, Guass lemma, the Eisenstein criterion, polynomial rings over commutative rings, unique factorization domain.

Field Theory:

Extension fields, Finite extension field, Algebraic extension, Algebraic number, Roots of polynomials, splitting fields, Uniqueness of Splitting fields, construction with Straightedge and compass, More about roots, Simple extension, Fixed fields, Elementary symmetric functions, normal extension, Galois group, The fundamental theorem of Galois theory.

References:

1. Herstein I.N. ,Topics in Algebra, Wiley eastern Ltd
2. Bhattacharya P. B. Basic Abstract Algebra, II edition Cambridge university press, 1995
3. Chon P.N. Algebra Vol. I & II, John wiley 1974.
4. Artin M. Algebra, Prentice Hall, Englewood, cliffs NJ,. 1991.

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Syllabus to be offered at M. Sc. Part-II Semester -III w.e.f. June 2011-12

Paper : 602
Advanced Functional Analysis

L T P
4-1-0

Inner product spaces and Hilbert spaces

Total Orthonormal Sets and Sequences, Representation of functional on Hilbert spaces, Hilbert-Adjoint operator, Self-adjoint, Unitary and Normal Operators

Fundamental theorems for Normed and Banach spaces

Zorn's Lemma, Hahn - Banach theorem, Hahn - Banach theorem for complex vector spaces and normed spaces, applications to Bounded linear functional on C [a , b], Adjoint operator, Reflexive spaces, Category theorem and uniform boundedness theorem, Strong and weak convergence, Convergence of sequences of operators and functional, Weak convergence, Open mapping theorem, Closed linear operators, Closed Graph theorem.

References:

1. E. Kreyszig: Functional Analysis and its application, John Wiley and sons.
2. B.V. Limaye: Functional Analysis, Wiley Eastern Ltd.
3. G.F. Simmons: Introduction to Topology and Modern Analysis, McGraw - Hill.
4. J.N. Sharma & A Vashistha: Functional Analysis.

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Syllabus to be offered at M. Sc. Part-II Semester -III w.e.f. June 2011-12

Paper : 603
Linear Algebra

L T P
4-1-0

Linear operator

Functions, linear operators, null space and range, rank and nullity theorem, operator inverses, application to matrix theory, computation of null space and range of a matrix, matrix of an operator, change of basis and similar matrices.

Inner Product Spaces

Preliminaries:

Definitions and examples,

Orthogonal sets:

Fourier coefficients and partial, Identity, gram-Schmidt process, QR factorization,

Approximation and Orthogonal projection:

Equivalence of the problems, Computations using orthogonal and nonorthogonal sets, normal equations, projection operators, M-k

Orthogonal complements:

Decomposition of the vector space, applications to an approximations and matrix theory,

The Gram Matrix and Orthogonal Change of Basis: matrix representation of an inner products, orthogonal change of bases, rank of gram matrix.

References:

1. J. T. Scheick, Linear algebra with application, Mc- Hill international addition, 1997.
2. S. Biswas Matrix algebra, New Age II edition 1997.
3. A. R. Rao Linear Algebra Tata - Mc-Graw-hill 1996.

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Syllabus to be offered at M. Sc. Part-II Semester -III w.e.f. June 2011-12

Paper : 604
Advanced Numerical Analysis

L T P
4-1-0

- **Differentiation and Intergration**
  Introduction
  Numerical Differentiation
  Partial Differentiation
  Numerical Integration
  Methods based on Interpolation
  Method based on undetermined coefficients
  Composite Integration methods
  Romberg Integration
  Double Integration

- **Ordinary Differential Equations** :
  Initial value problems
  Numerical methods
  Singlestep methods
  Multistep methods
  Predictor-corrector methods

- **Ordinary differential Equations** :
  Boundary value problem
  Initial value problem method
  Finite Difference methods
  Finite Element methods

References:

1. Jain, Iyenger & Jain : Numerical Methods, for Scientific and Engineering Computation, New-Age International. 1999

2. Froberg C. E. : Introduction to Numerical Analysis, Addison-Wesley, 1970

3. Philips and Taylor :Theory and Applications of Numerical Analysis Academic Press,1996

4. Gourdin and Boumhart :Applied Numerical Analysis, P.H.I., 1996

5. Householder A. S. :Theory of Matrices in Numerical Analysis, Blarsedell - New York.

6. Jacques and Colin : Numerical Analysis, Chapman & Hall, New-York, 1987

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Syllabus to be offered at M. Sc. Part-II Semester -III w.e.f. June 2011-12

Paper - 6001

Fluid Dynamics

L - T - P
4 - 1 - 0

- Vectors and Tensors:
- Flow Kinematics
- Flow descriptions (Lagrangian, Eulerian, Material derivative)
- Motion of Fluid particles(rate of dilation, rate of shear, rate of rotation)
- Conservation Laws
- Reynold's transport theorem
- Conservation of mass
- Conservation of momentum
- Conservation of energy
- Navier-stokes equation
- Non dimensionalization of the Navier-stokes equation
- Special form of conservation laws
- Euler equation for inviscid gas dynamics
- Parabolic boundary condition for N S equation
- Potential equation
- Laplace Equation for irrotational flows
- Incompressible inviscid irrotational flows
- Velocity potential and stream function in 2d and 3d
- Simple planer flows
- Incompressible Viscous flows

Reference Books:

1. Batchelor G.K.: An Introduction to Fluid Dynamics, Cambridge University Press,1999.
2. Emanuel G: Analytical Fluid Dynamics, CRC Press, Boca Raton, Second Edition, FL, 1999.
3. Panton R.L., Incompressible Flows, Wiley Interscience, 1984
4. Currie I.G.: Fundamental Mechanics of Fluids, McGraw-Hill, New-york, 1993.
5. Chorin: Mathematical introduction to Fluid Mechanics, Springer Verlag, Fourth Edition

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Syllabus to be offered at M. Sc. Part-II Semester -III w.e.f. June 2011-12

Paper - 6002

Mathematical Software

L - T - P
4 - 1 - 0

Introduction

Introduction to Matlab, variable and array, subarrays, displaying output data, data files operation on array, hierarchy of operation on array, built in function in Matlab

Plotting

Introduction to plotting, graph window, two dimensional plot, multiple plot, components of graph(legend, title,),graphical image, commet, 3D graph, additional plotting features
Subplots, polar plots,

Branching statement and program design

The if construct, switch construct, The try-catch construct , relational operators, logic operators, logical functions

Loops

The while loop, The for loop, The break and continue statements, Nesting loops.

User defined function

Introduction to Matlab functions, variable passing in Matlab(pass by value), preserving data between calls to functions, sub functions, private function, nested function

Reference books:

1. Chapman Stephen: Matlab programming for engineers, Thompson learning, 2004.
2. Rudra Pratap: getting started with Matlab, oxford university press, 2004

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Syllabus to be offered at M. Sc. Part-II Semester -III w.e.f. June 2011-12

Paper - 6003

Mechanics

L - T - P
4 - 1 - 0

FUNDAMENTALS OF PHYSICS

- Measurement
- Motion in one dimension: Displacement, Velocity, Acceleration, Equation of motion with constant acceleration.
- Motion in two dimension and three dimensions: Displacement, Velocity, Acceleration, Projectile Motion, Uniform circular motion, Relative motion in two and three dimension
- Newton Laws of motion (with examples), Friction and centripetal forces
- Kinetic energy and work ,Work done by weight, Work done by variable force, Work-kinetic energy theorem, Work done by spring force, Power, Potential energy and conservation of energy, Electric potential energy, Gravitational potential energy, Conservation of energy
- System of particles: Newton Laws for system of particle, Linear Momentum and Newton's second Law, Conservation of linear momentum, collision, Impulse and linear momentum, Elastic and Inelastic collision in one dimension, Collision in two dimension
- Rotational motion: Angular displacement, Angular velocity and Angular acceleration, Equation of motion for constant angular acceleration, Torque, Newton second law in angular form
- **Oscillations and wave theory**
- Oscillations: Energy, SHM, Energy in SHM, damped simple harmonic motion, forced oscillations and resonance, Simple pendulum
- Waves: Types of waves, wavelength, frequency, period, angular frequency, Superposition of waves
- **Heat and Thermodynamics**
- Thermodynamics : Zeroth Law of Thermodynamics
- The Celsius, Kelvin and Fahrenheit scales
- Thermal expansion: Linear expansion and volume expansion
- Specific heat
- First law of Thermodynamics
- Conduction, convection, radiation
- Kinetic theory of Gases and second law of Thermodynamics: Ideal gases, Internal energy, the Adiabatic expansion of an ideal gases, Entropy, Second law of thermodynamics, Entropy in the real world, Engines, Refrigerators

Reference Books:

1. D. Halliday, R. Resnick and J. Walker, Fundamentals of Physics, Sixth edition, John Wiley and Sons, New York, 1998.
2. J.B. Serway, Fundamental of Physics

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Syllabus to be offered at M. Sc. Part-II Semester - III w.e.f. June 2011-12

Paper : 6004
Combinatorics

L T P
4-1-0

Unit – I:

Introduction to basic ideas of ordered and unordered selection, The Binomial theorem, Combinatorial approach of the Binomial theorem, Binomial coefficients.

Unit – II:

Pairing problems, perfect matching, system of distinct representative, Optimal assignment problem, Hall's treatment to optimal assignment problem with priorities, marriage theorem.

Unit – III:

Latin squares and rectangles, the maximin theorem, recurrence relation, Fibonacci type relations, generating functions related to recurrence relations.

Unit – IV:

The inclusion-exclusion principle, Rook polynomials, computation of Rook polynomials for various types of board.

References:

1. Jan Anderson : A first course in Combinatorial mathematics,
2. V. Krishnamurty : Combinatorics: Theory and Applications, Affiliated East-West Press Ltd., New Delhi, 1985.
3. Herbert John Ryser : Combinatorial Mathematics, The Mathematical Association of America,USA (Carns Mathematical Monographs No.4).

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Syllabus to be offered at M. Sc. Part-II Semester -III w.e.f. June 2011-12

Paper - 6005

Linear Programming

L - T - P
4 - 1 - 0

Linear Programming:

General Linear Programming problem (LPP). Canonical and standard from of LPP, Simplex method, Fundamental properties of the solutions, Degeneracy in LPP, Solution of equations using simplex method. Concept of duality, Fundamental theorems of duality, Properties of duality, Revised simplex method.

Dynamic Programming:

Introduction, Recursive equation approach. Characteristic of dynamic programming. Solution of discrete dynamic programming problem, Solution of LPP by dynamic programming, Some application of dynamic programming.

Integer Pogramming:

Introduction, All and mixed integer programming problems (IPP), Gomory's all- IPP method, All-IPP algorithm. The branch and bound techniques. Zero - One programming.

Post-optimality Analysis

Sensitivity analysis, Discrete change in the cost-vector, in requirement-vector and in the coefficient matrix. Structural changes in LPP.

Reference:

1. Operations research by Kanti Swarup. P.K.Gupta and Nan Mohan. S. Chand & Sons, New Delhi, 7th ed. 1994. .
2. Operations Research by S.D.Sharma. Kedamath Ramnath Pub. 1998. Meerut.
3. Optimization: Theory and Applications by S.S.Rao. Wiley Eastern Ltd. 1979, New Delhi.
4. Applied Non-linear Programming by Himmelblan D.M.McGraw Hill Book Co. 1972.
5. Non-linear Programming by B.Martos. North - Holland Pub. Co. Amsterdam.

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Syllabus to be offered at M. Sc. Part-II Semester -III w.e.f. June 2011-12

Paper - 6006

Operation Research

L - T - P
4 - 1 - 0

Inventory Control:

Introduction to various types of inventory problems, Method with known demand function, Economic order quantity (EOQ),Deterministic inventory problems when shortages are allowed and not allowed, EOQ problems with price breaks, Multi item deterministic inventory problems, Inventory with uncertain demand, Inventory models with stochastic demand.

PERT - CPM :

Introduction to network with basic components, Rules of network construction, Time calculation in network, CPM, PERT, PERT calculations, Advantages of PERT-CPM, Project cost, Time-cost, Optimization algorithm, Resource allocation and scheduling.

Transportation Problem:

Definition of transportation problem, Basic feasible solution (BFS) to transportation problem, Different methods for finding BFS to the transportation problem, Method of finding optimum solution to the transportation problem, Degeneracy for transportation problem. Unbalanced transportation problem.

Assignment Problem:

Definition of assignment problem, unbalanced assignment problem.

Reference:

[1] Operations research by Kanti Swarup, P.K.Gupta and Nan Mohan. S.Chand & Sons, NewDelhi. 7th ed.1994.

[2] Linear Programming by G.Hadley. Oxford & IBH Pub. Co. 1969. [3]

Linear and Non-linear Programming by K.G.Murthy.

[4] Operations Research by S.D. Sharma. Kedarnath Ramnath Pub.1998. Merrut.

[5] Optimization: Theory and Application by S.S.Rao. Wiley Eastern Ltd. 1979, New Delhi.

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Syllabus to be offered at M. Sc. Part-II Semester - IV w.e.f. June 2011-12

Paper : 6007
Integral Transform-I

L T P
4-1-0

Laplace Transforms:

- Introduction and definition of Laplace transforms with examples,
- Existence condition and basic properties of Laplace transforms,
- The convolution theorem and properties of convolution,
- Differentiation and integration of Laplace transforms,
- The inverse Laplace transforms and examples,
- Tauberian theorem and Watson's lemma,
- Laplace transforms of fractional integrals and fractional derivatives,.

Finite Laplace Transforms:

- Introduction,
- Definition of finite Laplace transforms with examples,
- Basic operational properties of finite Laplace transforms,

Applications of Laplace Transforms

- Application of Laplace transforms to ordinary and partial differential equations;
- Initial and boundary value problems and Integral equations;
- Evaluation of definite integral
- Solution of difference as well as differential equations.
- Application of finite Laplace transforms and Tauberian theorem.

References:

1) Ian Sneddon : The use of Integral Transform. TMIH, 1979.
2) Lokenath Debnath : Integral Transform and their applications, CRC Pub., 1995.
3) B. Davies : Integral Transforms and their applications, Springer - Verlag, 1978.
4) Boss M. L. : Mathematical Methods in Physical Sciences, John Wiley & Sons, 1983.
5) Andrews, L. G. & Shivamoggi B. K. : Integral Transforms for Engineers, PHI, 2003.

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Syllabus to be offered at M. Sc. Part-II w.e.f. June 2011-12

Paper : 6008
Advanced Integral Transform-I

L T P
4-1-0

Hankel Transforms:

- Introduction and definition of Hankel transforms with examples,
- Operational properties of the Hankel transforms

.

Finite Hankel Transforms:

- Introduction and definition of the finite Hankel transforms with examples,
- Basic operational properties

Application Hankel transforms:

- Application Hankel transforms to partial differential equations
- Applications of finite Hankel transforms.

Hilbert and Stieltjes Transforms (HST):

- Introduction and definition of HST with examples,
- Basic operational properties of HST,
- Hilbert transform in the complex plane and its applications,
- Inverse theorem for Stieltjes transform and its application,
- Asymptotic expansion of the one sided Hilbert transform,
- The generalized Stieltjes transform,
- Basic properties of the generalized Stieltjes transforms with applications.

References:

1) Ian Sneddon : The use of Integral Transform. TMIH, 1979.
2) Lokenath Debnath : Integral Transform and their applications, CRC Pub., 1995.
3) B. Davies : Integral Transforms and their applications, Springer - Verlag, 1978.
4) Boss M. L. : Mathematical Methods in Physical Sciences, John Wiley & Sons, 1983.
5) Andrews, L. G. & Shivamoggi B. K. : Integral Transforms for Engineers, PHI, 2003.

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Syllabus to be offered at M. Sc. Part-II Semester - III w.e.f. June 2011-12

Paper : 6009
Elementary Number Theory

L T P
4-1-0

Unit – I:

Divisibility in integers, Division algorithm, Greatest Common Divisor (gcd) using the Euclidean Algorithm, property of gcd and lcm of two integers, Fundamental theorem of arithmetic, linear Diophantine equation in two variables.

Unit – II:
Prime and composite numbers, The Fundamental theorem of Arithmetic, Sieve of Eratosthenes, Infinitude of primes, Upper bound for the primes.
Fibonacci numbers and their elementary properties.

Unit –III:
Properties of congruence relation, Modular Arithmetic, Divisibility tests for 3, 9 and 11, CRS(mod n) and RRS(mod n), linear congruence $ax \equiv b \pmod{n}$, Chinese Remainder theorem.

Unit –IV:
Fermat's little theorem, pseudo-primes, Wilson's theorem.
Pythagorean triples, Pythagorean equation $x^2 + y^2 = z^2$.

References:

1. David M. Burton : Elementary Number Theory, Tata McGraw-Hill Pub. Co., N. Delhi, 6th edition, Reprint, 2006.
2. Neville Robbins : Beginning Number Theory, Narosa Pub. House, N.Delhi, 2nd Ed., 2006.
3. I. Niven, S.Zuckerman & L. Montgomery: An Introduction to the Theory of Numbers, 6th edition, John Wiley and Sons, Inc., New York, 2003.
4. George Andrews : Number Theory, The Hindustan Pub. Corp., New Delhi.
5. S.G.Talang : Number Theory, The Tata McGraw Hill Co. Ltd., New Delhi.

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Syllabus to be offered at M. Sc. Part-II Semester - III w.e.f. June 2011-12

Paper : 6010
Algebraic Number Theory

L T P
4-1-0

Unit – I:

Uniqueness of factorization of integers in rational and Gaussian fields, Polynomials over a field, Eisenstein's irreducibility criterion, Symmetric polynomials, Symmetric function theorem.

Unit – II:

Algebraic and transcendental numbers, algebraic number fields, bases and finite extensions, conjugates of an algebraic number fields, conjugate of an algebraic number in a given algebraic number field.

Unit – III:

Algebraic integers, norm, trace and discriminant of algebraic numbers and algebraic integers, integral basis of an algebraic number field, arithmetic in algebraic number fields

Unit – IV:

Units and primes, the problem of uniqueness of factorization, integral ideals, basic properties of ideals, unique factorization of integral ideals, HCF of two ideals, problem of ramification.

References:

1. Harry Pollard and Harold G. Diamond : The Theory of Algebraic numbers, The Mathematical Association of America (Carns Mathematical Monographs).
2. S. Lang, Algebraic Number Theory, Addison- Wesley, 1970.
3. D.A. Marcus, Number Fields, Springer-Verlag, Berlin, 1977.
4. K. Ireland and M. Rosen, A Classical Introduction to Modern Number Theory, 2nd ed., Springer-Verlag, Berlin, 1990.

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Syllabus to be offered at M. Sc. Part-II Semester - IV w.e.f. June 2011-12

Paper : 6011
Special Functions - I

L T P
4-1-0

Infinite Products :

Definition of an Infinite product, A necessary condition for convergence, The associated series of logarithms, Absolute convergence, Uniform convergence.

THE GAMA AND BETA FUNCTIONS:

The Euler or Mascheroni constant γ, The Gama function, A series for $\Gamma'(z)/\Gamma(z)$, Evaluation of $\Gamma(1)$ and $\Gamma'(1)$, The Euler product for $\Gamma(z)$, The difference equation $\Gamma(z+1) = z\Gamma(z)$, The order symbols o and O, Evaluation of certain infinite products, Euler integral for $\Gamma(z)$, The Beta function, The value of $\Gamma(z)\ \Gamma(1-z)$, The factorial function, Legendre's duplication formula, Gauss' multiplication theorem, A summation formula due to Euler, The behavior of $\log \Gamma(z)$ for large $|z|$.

THE HYPERGEOMETRIC FUNCTION:

The function F(a, b; c; z), A simple integral form, F(a, b; c; 1) as a function of the parameters, Evaluation of F(a, b; c; 1), the contiguous function relations, The hypergeometric differential equation, Logarithmic solutions of the hypergeometric equation, F(a, b; c; z) as a function of its parameters, Simple transformations, Relation between functions of Z and 1-Z, A quadratic transformation, other quadratic transformations, a theorem due to Kummer, Additional properties.

Reference:

1. E. D. Rainville, Special Functions, McMillan, New York, 1990.
2. I. N. Sneddon, Special functions of Mathematical Physics and Chemistry, Oliver Boyd.
3. N. N. Lebdev, Special Functions and their applications, Dover Pub. 1972.
4. R. K. Saxena and D. C. Gokhroo, Special Functions, Khanna Pub.

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Syllabus to be offered at M. Sc. Part-II Semester - IV w.e.f. June 2011-12

Paper : 6012
Special Functions - II

L T P
4-1-0

GENERALIZED HYPERGEOMETRIC FUNCTIONS:

The function ${}_pF_q$, The exponential and binomial functions, A differential equation, Other solutions of the differential equation, The contiguous function relations, A simple integral, The ${}_pF_q$ with unit argument, Saalschutz' theorem, Whipple's theorem, Dixen's theorem, Contour integrals of Barns' type, The Berns' integrals and the function ${}_pF_q$, A useful integral.

BESSEL FUNCTIONS:

Remarks, Definition of $J_n(z)$, Bessel's differential equation, Differential recurrence relations, A pure recurrence relations, A generating function, Bessel's integral, Index half of an integer, Modified Bessel functions, Neumann polynomials, Neumann series.

THE CONFLUENT HYPERGEOMETRIC FUNCTION:

Basic properties of the ${}_1F_1$, Kummer's first formula, Kummer's second formula.

GENERATING FUNCTIONS:

The generating function concept, Generating functions of the form G($2xt - t^2$), sets generated by $e^t \psi(xt)$, the generating functions $A(t)\exp(-xt/(1-t))$, another class of generating functions, Boas and Buck generating functions, An extension.

Reference:

1. E. D. Rainville, Special Functions, McMillan, New York, 1990.
2. I. N. Sneddon, Special functions of Mathematical Physics and Chemistry, Oliver Boyd.
3. N. N. Lebdev, Special Functions and their applications, Dover Pub. 1972.
4. R. K. Saxena and D. C. Gokhroo, Special Functions, Khanna Pub.

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Syllabus to be offered at M. Sc. Part-II Semester - IV w.e.f. June 2011-12

Paper : 60113
Neural Network

L T P
4-1-0

Definition and brief history of artificial neural networks.

- Structure and function of a Single Neuron, Biological Neuron and artificial Neuron Models
- Architectures and Neural Networks:
    - Fully connected
    - Layered networks
    - Feed forward
    - A cyclic and modular networks
- Supervized and Unsupervized networks
- Learning Algorithms:
    - Correlation learning
    - Competitive learning
    - Habbian rule
    - Perceptron rule
    - Delta rule
    - Back propagation algorithm.
- Hopfield Networks
    - Continuous and Discrete
    - Energy function and its properties
    - Capacity of Hopfield Networks.

References:

1. Heykin S: Neural Networks : A Comprehensive Foundation, McMillan, N.Y, 1994
2. Kohonen. T: Self-Organization and Associative Memory.
3. Kosko B: Neural Networks and Fuzzy Systems : Prentice Hall, Y.J, 1992.
4. K Mehrotra, C.K. Mohan, S. Ranka : Artificial Neural Networks, Penram International Publishing, 1977.

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Syllabus to be offered at M. Sc. Part-II Semester - IV w.e.f. June 2011-12

Paper : 6014
Fuzzy Modeling

L T P
4-1-0

Introduction:

Basic concepts of Fuzzy sets theory, Basic concepts of Fuzzy subsets, operations on fuzzy sets, fuzzy relationship, the extension principle and Fuzzy arithmetic, measures of fuzziness

Aggregation Operations on fuzzy sets

Intersection and union of fuzzy sets, weighted union and intersections, nonmonotonic fuzzy operations, mean aggregation operators, ordered weighted averaging operators, fuzzy measures and integrals

References:

1. Yager R.R. and Filev D.P., "Essentials of fuzzy modeling and control" Wiley New York
2. Zimmermann H.J.,"Fuzzy set theory and its applications" Allied Publication
3. Klir. G.K. & Yuan B., "Fuzzy sets and logic" Prentice Hall of india New Delhi 1995

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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 701
Advanced Abstract Algebra

L T P
4-1-0

Normal Series and Conjugacy and G.Sets :

Normal series, solvable groups, Nilpotent groups.

Ideals and homeomorphisms:

Ideal of a ring, principal ideal ring, finitely generated ideal, Quotient ring, Ring homomorphism, Fundamental theorem of Homomorphism, Correspondence theorem, Anti-homomorphism, Anti-isomorphism, The opposite ring of a ring, sum and direct sum of ideals, Maximal and prime ideals, Product of two ideals, Nilpotent and nil ideals.

Modules:

Modules, sub-modules, finitely generated module. Direct sum of sub-modules, Homomorphism and quotient modules, Fundamental theorem of R-homomorphism, completely reducible modules, Schur's lemma, Free modules, Noetherian and artinian modules, Hilbert basis theorem, Wedderbum-Artin theorem, Maschket's theorem, Uniform modules, Primary modules. Noether-Lasker theorem.

References:

1. Bhattacharya P. B. Basic Abstract Algebra, II edition Cambridge university press, 1995.
2. Herstein I.N., Topics in Algebra, Wiley eastern Ltd.
3. ChonP.N. Algebra Vol. I & II, John wiley 1974.
4. Artin M. Algebra, Prentice Hall, Englewood, Cliffs NJ,. 1991

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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 702
Theory of Operators

L T P
4-1-0

Compact Linear operators on Normed spaces and Their Spectrum:
Compact Linear Operators on Normed Spaces, Further Properties of Compact Linear Operators, Spectral Properties of Compact Linear Operators on Normed Spaces, Further Spectral Properties of Compact Linear Operators, Operator Equations Involving Compact Linear Operators, Further Theorems of Fredholm Type, Fredholm Alternative,

Spectral Theory of Bounded Self-Adjoint Linear Operators:
Spectral Properties of Bounded Self-Adjoint Linear Operators, Further Spectral Properties of Bounded Self-Adjoint Linear Operators, Positive Operators, Square Roots of a Positive Operator, Projection Operators, Further Properties of Projections, Spectral Family, Spectral Family of a Bounded Self-Adjoint Linear Operator, Spectral Representation of Bounded Self-Adjoint Linear Operators, Extension of the Spectral Theorem to Continuous Functions, Properties of the Spectral Family of a Bounded Self-Adjoint Linear Operators,

Unbounded Linear Operators in Hilbert Space:
Unbounded Linear Operators and their Hilbert-Adjoint Operators, Hilbert-Adjoint Operators, Symmetric and Self-Adjoint Linear Operators, Closed Linear Operators and Closures, Spectral Properties of Self-Adjoint Linear Operators, Spectral Representation of Unitary Operators, Spectral Representation of Self-Adjoint Linear Operators, Multiplication Operators and Differentiation Operators.

References:

1. Kreyszig E. : Introductory Functional Analysis with applications, Wiley India, 2006
2. Simmons G. F. : Introduction to Topology and Modern Analysis. McGraw Hill
3. Siddiqui A. H. : Functional Analysis, P.H.I.
4. Sudarshan Nanda : Functional Analysis, Wiley Eastern Pvt. Ltd.
5. Day M.M. : Normed Linear spaces, Springer
6. Limaye B.V. : Functional Analysis, New Age International Pvt. Ltd.

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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 703
Advance Topology

L T P
4-1-0

Separation Axioms:

Definitions:

- Ti and T_2 Spaces with theorems and examples on it
- Regular, completely regular and Normal spaces with their relations and examples & theorems
    - Uryshon's lemma and Tietz's extension theorem

Connected Spaces:

- Definitions and examples,
- Continuity and connectedness
- Disconnected spaces
- Product of connected spaces
- Connectedness of R^n and C^n

Component of space:

- Definition and examples
- Theorems and examples on connected spaces

Totally Disconnected Space:

- Definition and examples
- Theorems and examples on totally disconnected spaces

Locally Connected space:

- Definition and examples
- Theorems related to locally connected spaces

References:

1. George F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Co., 1963.
2. James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
3. J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by Prentice Hall of India Pvt. Ltd.).
4. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.
5. J. Hocking and G. Young, Topology, Addison-Wesley, Reading, 1961.

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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 704

Advance Ordinary Differential Equation

L T P
4-1-0

Stability of Linear and Weakly Nonlinear Systems:

Introduction, Continuous Dependence and Stability Properties of Solutions: Definitions of stability, Examples on stability, Theorems on stability, Linear Systems: Definitions Theorems, corollary, examples on linear systems, Weakly Nonlinear systems, Two dimensional systems: equilibrium point, critical point, phase space, phase portraits, two-dimensional linear autonomous systems, nonzero roots with different and same sign, one root is zero and other is nonzero, Linearly dependent characteristic vectors, Linearly independent characteristic vectors, complex conjugate roots.

Second Order Differential Equations:

Introduction, Preliminary Results, normal form, Riccati equation, General Riccati equation, equations of the form u" + a(t)u = 0, u" + (l+b(t))u = 0, u" + (l+b(t)+c(t))u = 0, Boundedness of Solutions: L^2-Boundedness, Cauchy-Schwartz inequality, boundedness of |(u|| *and [\u'* , Application to Some Classical Equations.

References:

[1] Shair Ahmad and M Rama Mohana Rao, Theory of Ordinary Differential Equations, Affiliated East-West Press Pvt. Ltd., New Delhi, 1999.

[2] P. Hartman, Ordinary Differential Equations, John Wiley, 1964.

[3] W. T. Reid, Ordinary Differential Equations, John Wiley, New York, 1971.

[4] E. A. Coddington and N. Levinson, Theory of Ordinary Differential Equations, McGraw Hill, NY, 1955.

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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 7001
Computational Fluid Dynamics

L T P
4-1-0

- Introduction to CFD, Applications;
- Governing equations and assumptions, Equation types, Model equations, potential flow, Heat conduction, Wave equation, Burgers equation, Euler equations.
- Finite Differences, Algorithms, Errors and Accuracy, Consistency, Stability and Convergence, Finite Volumes, Explicit algorithms, Implicit algorithms, Numerical boundary conditions, Method of lines, Shock Jump Relations, Shock capturing.
- One dimensional Euler equations, Lax – Wendroff Scheme, Mc-Cormack Scheme, Implicit - method, Pseudo One Dimensional Euler Equations, boundary conditions, Flux – Splitting, Artificial viscosity, Flux limiters.
- Multidimensional Euler equations, Lax- Wendroff and Mc-Cormack schemes, stability of multidimensional schemes, Operator splitting Implicit algorithms, Beam - Warming algorithm.
- Practicals : Numerical methods for discretizing fluid flow equations: Finite differences, finite element and finite volume method.

Reference Books:

1. R. J. Leveque: Numerical methods for conservation Laws, Birkhauser Verlag, Basel, 1992.
2. J. D. Anderson: Computation Fluid dynamics, Mc-Graw – Hill, New York, 1995.
3. H. K. Versteeg and W. Malasekera: An Introduction to Computational Fluid Dynamics: The finite volume method, Longman Scinetific and technical Essex, England, 1995.
4. J. Chorin and J. E. Marsden: A Mathematical Introduction to Fluid Mechanics
5. P. D. Lax: hyperbolic systems of conservation laws and mathematical theory of shock waves, 1973.

DEPARTMENT OF MATHEMATICS,
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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 7002
Mathematical Modeling

L T P
4-1-0

- Needs and Techniques of mathematical modeling: Idea of mathematical modeling, need for mathematical modeling, steps in mathematical modeling, Characteristics of mathematical modeling ,Interpretation
- Models in mechanical vibration :Spring mass system, pendulum problems
- Models in population dynamics:One species model, logistic model, growth model in time delays ,Predator-Prey models,Volterra-Lotka models
- Models of chemical processes, Electrical network and Diffusion processes
- Traffic flow models

COMPUTATIONAL MODELING

- Modeling dynamical systems: differential equations and their numerical solution, linear and non–linear dynamics, stability, convergence, attractors.
- Physical systems: System types and characteristics behaviour, Continuous-time,discrete – time and discrete -event systems, linear and non linear systems
- Exploration of behaviour through simulation:

Developing simulations of dynamical systems using Matlab: representation and visualization of simulation experiments, analyzing behavioural characteristics for a range of classes of physical and computational systems eg. Predictor- prey models, evolutionary systems and cellular systems

Reference Books:

1. J.N.Kapur: Mathematical modelling, Wiley eastern Ltd., 1994.
2. M.M. Gibbons: A concrete approach to Mathematical modeling, John Wiley and sons, 1995.
3. H. Neunzert and A.H. Siddiqui: Topics in Industrial Mathematics, Kluwer Academic Publishers, London, 2000
4. P. E. Wellstead : Introduction to Physical system modeling, Academic Press, 1979.
5. Richard Haberman: Mathematical Models, Practice- Hall Inc., NJ, 1979.
6. Jery Banks, John S., Carson II, Barry Nelson and David M.Nicol,:Discrete – Event system simulation , Prentice hall, 2001

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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 7003
Finite Element Method

L T P
4-1-0

- Introduction
- The basic idea about FEM,
- basic features of FEM,
- mathematical model,
- numerical simulations
- Mathematical Preliminaries
- Integral formulations
- Variational methods
- Basic steps of Finite Element Analysis
- Axisymmetic Problems
- Discrete systems

Reference Books:

1. J.N.Reddy: "An introduction to the Finite Element Method" Tata McGraw - Hill Edition, 2005.

2. Baker A. J.: "Finite Element Computational Fluid Mechanics" McGraw Hill Book Company

3. Chung T. J.: "Computation Fluid Dynamics" Cambridge University Press

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Paper : 7004
Wavelet Analysis

L T P
4-1-0

- From Fourier Analysis to Wavelet analysis
- Time Frequency Analysis
- Continuous Wavelet Transform
- Discretizing the Wavelet Transform
- Frames
- Frames of Wavelets
- A necessary condition (Admissibility of the mother wavelet)
- The dual frame
- Examples of Tight frames, The Mexican hat function, a modulated Gaussian
- Frames for the Windowed Fourier transform
- Time-Frequency Density
- Orthonormal Wavelet bases
- Multi Resolution Analysis
- Riesz bases of scaling function
- The Battle-Lemaire waveltes
- Regularity of Orthonormal wavelet bases
- Orthonormal Bases of Compactly Supported Wavelets with Examples
- Regularity of Compactly Supported Wavelets

Books:

1. Ingrid Daubechies :Ten Lectures on Wavelets, OBMS-NSF SIAM, Philadelphia,

1992.

2. Charles K. Chui An introduction to wavelets, Academic Press ,1992

3. G. Kaiser, Friendly Guide to wavelets , Birkhauser Boston 1994.

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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 7005
Non - Linear Programming

L T P
4-1-0

One - Dimensional Non- Linear Programming Methods

Unimodal function, exhaustive search, dichotomous search, Fibonacci search, quadratic interpolation , direct search method, interpolation methods

Classical Optimization Methods

Unconstraint optimization, constrain Multi- variable optimization with equality constrains, constrain Multi- variable optimization with inequality constrains,

Non- Linear Programming Methods

Introduction, general non- linear programming problems, graphical solution method, quadratic programming, application of quadratic programming, separable programming, geometric programming, stochastic programming

Books:

1. Kantiswarup, P.K.Gupta and Manmohan: Operations Research ,Sultan chand and Sons.
2. S.D. Sharma: Operations Research, Kedar Nath, Ram Nath & Co.
3. S. S. Rao: Optimization Theory and Applications, Wiley Eastern, 1984
4. B.E. Gillet : Introduction to Operation Research Computer Oriented algorithm
5. H.A. Taha :Operation research an Introduction
6. Kalyanmoy Deb : Optimization for Engineering Design, Algorithms and
7. Examples Prentice-Hall of New Delhi, India, 2000
8. Srinath L.S.:PERT and CPM : Principles and Applucations ,2nd edition ,1975.

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Paper : 7006
Advanced Operational Research

L T P
4-1-0

Queuing Theory:

Definition and characteristic of a queuing system, Poisson process and exponential distribution, Classification of queues, Detailed study of MIMII and MfMIc queuing models,

Sequencing Problems:

Problems of sequencing, Problems with n-jobs and 2-machines, Problems with n-jobs and 3-machines, Problems with 2-jobs and n-machines.

Theory of Replacement:

Introduction, Replacement of equipment that deteriorate gradually, Replacement of equipment that fails completely,Other replacement problems.

Referece:

[1] Operations research by Kanti Swarup, P.K.Gupta and Nan Mohan. S.Chand & Sons, NewDelhi. 7th ed.1994.

[2] Linear Programming by G.Hadley. Oxford & IBH Pub. Co.

1969. [3] Linear and Non-linear Programming by K.G.Murthy.

[4] Operations Research by S.D. Sharma. Kedarnath Ramnath Pub.1998. Merrut.

[5] Optimization: Theory and Application by S.S.Rao. Wiley Eastern Ltd. 1979, New Del hi

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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 7007
Integral Transforms-II

L T P
4-1-0

Fourier Transforms:

- Introduction,
- Basic concepts and definitions,
- The Fourier Integral formulae,
- Definition and examples of Fourier transforms,
- Basic properties of Fourier transforms,
- Applications of Fourier transforms to ordinary differential equations; integral equations and partial differential equations,
- Fourier cosine and sine transforms with examples,
- Properties of Fourier cosine and sine transforms,

Finite Fourier Cosine and Sine Transforms:

- Introduction and definition of finite cosine and sine transforms with examples,
- Basic properties of finite Fourier cosine and sine transforms

Applications of Fourier Transforms:

- Application of Fourier cosine and sine transforms to partial differential equations
- Evaluation of definite integrals.
- Application of finite Fourier cosine and sine transforms.

References:

1) Ian Sneddon : The use of Integral Transform. TMIH, 1979.
2) Lokenath Debnath : Integral Transform and their applications, CRC Pub., 1995.
3) B. Davies : Integral Transforms and their applications, Springer - Verlag, 1978.
4) Boss M. L. : Mathematical Methods in Physical Sciences, John Wiley & Sons, 1983.
5) Andrews, L. G. & Shivamoggi B. K. : Integral Transforms for Engineers, PHI, 2003.

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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 7008
Advanced Integral Transforms-II

L T P
4-1-0

Mellin Transforms:

- Introduction and definition of Mellin transforms with examples,
- Basic operational properties
- Applications of the Mellin transforms,
- Mellin transforms of the Weyl fractional integrals
- Weyl fractional derivatives
- Application of Mellin transforms to summation of series.

Z-Transforms:

- Introduction,
- Dynamic linear systems
- and Impulse response,
- Definition of the Z-transforms and examples,
- Basic operational properties,
- The inverse Z-transform and examples,
- Application of Z-transforms to finite difference equations.

References:

1) Ian Sneddon : The use of Integral Transform. TMIH, 1979.
2) Lokenath Debnath : Integral Transform and their applications, CRC Pub., 1995.
3) B. Davies : Integral Transforms and their applications, Springer - Verlag, 1978.
4) Boss M. L. : Mathematical Methods in Physical Sciences, John Wiley & Sons, 1983.
5) Andrews, L. G. & Shivamoggi B. K. : Integral Transforms for Engineers, PHI, 2003.

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Syllabus to be offered at M. Sc. Part-II Semester - IV w.e.f. June 2011-12

Paper : 7009
Advance Number Theory

L T P
4-1-0

Unit – I:

Introduction of Number theoretic functions $\tau(n)$, $\sigma(n)$, $\mu(n)$, $\phi(n)$ and $[x]$, Multiplicative nature of these functions, Basic properties of these functions, The Mobius Inversion formula, Use of the $[x]$ to compute exponent of highest powers of p that divides n!, Euler's generalization of Fermat's theorem.

Unit – II:

The order of an integer modulo n, Primitive roots for primes, The theory of indices.

Unit – III:

Euler's criterion, The Legendre symbol and its properties, Gauss' Lemma, Quadratic Reciprocity and Quadratic Reciprocity law, Quadratic congruence with composite moduli.

Unit – IV:

Simple continued fractions, finite and infinite continued fractions, uniqueness, representation of rational and irrational numbers as simple continued fractions, rational approximation to irrational numbers, Hurwitz theorem, basic facts of periodic continued fractions and their illustrations (without proofs).

References:

1. David M. Burton : Elementary Number Theory, Tata McGraw-Hill Pub. Co., N. Delhi, 6th edition, Reprint, 2006.
2. Neville Robbins : Beginning Number Theory, Narosa Pub. House, N.Delhi, 2nd Ed., 2006.
3. I. Niven, S.Zuckerman & L. Montgomery: An Introduction to the Theory of Numbers, 6th edition, John Wiley and Sons, Inc., New York, 2003.
4. George Andrews : Number Theory, The Hindustan Pub. Corp., New Delhi.
5. S.G.Talang : Number Theory, The Tata McGraw Hill Co. Ltd., New Delhi.

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Paper : 7010
Analytic Number Theory

L T P
4-1-0

Unit – I:
The Dirichlet product of two arithmetical functions (a.f.) and group structure w.r.t. this product, The Mangoldt function, Multiplicative a.f., the inverse of a completely multiplicative a.f., Liouville's function $\lambda(n)$, the divisor functions $d(n)$ and $\sigma_\alpha(n)$.

Unit – II:
Generalized convolution, the Bell series of a.f., the Selberg's identity, the big oh notation, Euler's summation formula, the average order of divisor functions $d(n)$ and $\sigma_\alpha(n)$.

Unit – III:
The average order of functions $\varphi(n), \mu(n), \Lambda(n)$, Lattice points visible from the origin, the partial sums of a Dirichlet product, applications to $\mu(n)$ and $\Lambda(n)$.

Unit – IV:
Chebyshev's functions $\psi(x)$ and $\mathcal{I}(x)$, Abel's identity, relation between $\mathcal{I}(x)$, $\pi(x)$, and $\psi(x)$, equivalent forms of prime number theorem, lower and upper bounds for $\pi(n)$ and p_n.

References:

1. T.M.Apostol : Introduction to Analytic Number Theory, Narosa Pub. House, New Delhi, 1998 Ed.
2. Mc Carthy P.J. : Introduction to Arithmetical function, Springer-Verlag, New York, 1986.
3. K. Chandrashekharan : Introduction to Analytic Number Theory, Springer-Verlag, New York, 1968.
4. Hua L.K. : Introduction to Number Theory, Springer-Verlag, New York, 1982.

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Syllabus to be offered at M. Sc. Part-II Semester - IV w.e.f. June 2011-12

Paper : 7011
Special Functions - III

L T P
4-1-0

ORTHOGONAL POLYNOMIALS:

Simple set of polynomials, Orthogonality, an equivalent condition for Orthogonality, zeros of orthogonal polynomials , Expansion of polynomials, The three term recurrence relations, The Christoffel-Darboux formula, Normalization; Bessel's inequality.

LEGENDRE POLYNOMIALS:

A generating function, differential recurrence relations, The pure recurrence relations, Legendre's differential equation, The Rodrigues formula, Bateman's generating function, Additional generating functions, Hypergeometric forms of $P_n(X)$, Brafman's generating functions, Special properties of $P_n(X)$, More generating functions, Laplace's first integral form, Some bounds on $P_n(X)$, Orthogonality, An expansion theorem, Expansion of Xn , Expansion of analytic functions,

HERMITE POLYNOMIALS:

Definition of Hn(x), Recurence relations, The Rodrigues formula, Other generating functions, Integrals, The Hermite polynomial as a ${}_2F_0$, Orthogonality, Expansion of polynomials, More generating functions.

Reference:

1. E. D. Rainville, Special Functions, McMillan, New York, 1990.
2. I. N. Sneddon, Special functions of Mathematical Physics and Chemistry, Oliver Boyd.
3. N. N. Lebdev, Special Functions and their applications, Dover Pub. 1972.
4. R. K. Saxena and D. C. Gokhroo, Special Functions, Khanna Pub.

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Syllabus to be offered at M. Sc. Part-II Semester - IV w.e.f. June 2011-12

Paper : 7012
Special Functions - IV

LTP
4-1-0

LAGUERRE POLYNOMIALS:

The polynomial Ln(X), Generating functions, Recurrence relations, The Rodrigues formula, The differential equation, Orthogonality, Expansion of polynomials, Special properties, Other generating functions, The simple Laguerre polynomials.

JACOBI POLYNOMIALS:

The Jacobi polynomials, Bateman's generating functions, The Rodrigues formula, Orthogonality, Differential recurrence relations, The pure recurrence relations, Mixed relations, Appell's functions of two variables, An elementary generating functions, Brafman's generating functions, Expansion in series of polynomials.

ELLIPTIC FUNCTIONS:

Doubly periodic functions, Elliptic functions, Elementary properties, Order of an elliptic function, The Weierstrass function P(Z), Other elliptic functions, A differential equation for P(Z), Connection with elliptic integrals.

Reference:

1 E. D. Rainville, Special Functions, McMillan, New York, 1990.
2 I. N. Sneddon, Special functions of Mathematical Physics and Chemistry, Oliver Boyd.
3 N. N. Lebdev, Special Functions and their applications, Dover Pub. 1972.
4 R. K. Saxena and D. C. Gokhroo, Special Functions, Khanna Pub.

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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 7013
Digital signal Processing

L T P
4-1-0

INTRODUCTION:

DISCRETE-TIME SIGNALS AND SYSTEMS:

Introduction, Discrete-Time Signals: Sequences, Discrete-Time systems, Linear Time-Invariant Systems, Properties of Linear Time-Invariant Systems, Linear Constant-Coefficient Difference Equations, Frequency-Domain Representation of Discrete-Time Signals and Systems, Representation of Sequences by Fourier Transforms, Symmetry Properties of the Fourier Transform, Fourier Transform Theorems, Discrete-Time Random Signals.

THE Z-TRANSFORM:

Introduction, Z-Transform, Properties of the Region of Convergence for the Z-Transform, The Inverse Z-Transform, Z-Transform Properties.

SAMPLING OF CONTINUOUS - TIME SIGNALS:

Introduction, Periodic Sampling, Frequency-Domain Representation of Sampling, Reconstruction of a Band limited Signal from its Samples, Discrete-Time Processing of Continuous-Time Signals, Continuous-Time Processing of Discrete-Time Signals, Changing the Sampling Rate Using Discrete-Time Processing, Multi rate Signal Processing, Digital Processing of Analog Signals, Oversampling and Noise Shaping in A/D and D/A Conversion.

References:

1. Oppenheim A. V., Schafer & Buck “Discrete Time Signal Processing” Pearson education 2006
2. Crochiere & Rabiner “Multi rate Digital Signal Processing” Pearson education 2006
3. Oppenheim A. V., Schafer, “Digital Signal Processing” Pearson education 2006

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Syllabus to be offered at M. Sc. Part-II Semester -IV w.e.f. June 2011-12

Paper : 7014
Image Processing

L T P
4-1-0

Image Formations and Representation

Introduction, Image formation, Illumination, Reflectance Models, Point Spread Function, Sampling and Quantization, Image Sampling, Image Quantization, Binary Image, Geometric Properties, Chain code representation of a binary object, Three-Dimensional Imaging, Stereo Images, Range Image Aquisition, Image file formats

Colors and Color Imagery

Introduction, Perception of Colors, Color Space Quantization and Just Noticeable Difference, Color Space and Transformation, CMYK, NTSC or YIQ Color, YCbCr Color, Perceptually Uniform Color, CIELAB color, Color Interpolation or Demosaicing, Nonadaptive Color Interpolation Algorithms, Adaptive algorithms, A Novel Adaptive Color Interpolation Algorithm,

Image Transformations

Introduction, Fourier Transforms, One-Dimensional Fourier Transform, Two-Dimensional Fourier Transform, Discrete Fourier Transform (DFT), Transformation Kernels, Matrix Form Representation, Properties, Fast Fourier Transform, Discrete Cosine Transform, Walsh-Hadamard Transform (WHT), Karhaunen-Loeve Transform or Principal Component Analysis, Covariance Matrix, Eigenvectors and Eigen values, Principal Component Analysis, Singular Value Decomposition

Reference Books:

1. Tinku Acharya & Ajoy K. Ray, 'Image Processing ,Principles and Applications' WILEY- INTERSCIENCE
2. Gonzalez & Woods, "Digital image processing" Pearson Education second edition