

MATHEMATICS DEPARTMENT  
VEER NARMAD SOUTH GUJARAT UNIVERSITY  
SURAT

**M.Sc. Applied 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
AM – 101	Real Analysis	4	--	4	30	70	--	--	30	70
AM – 102	Ordinary Differential Equations	4	--	4	30	70	--	--	30	70
AM – 103	Linear Algebra	4	--	4	30	70	--	--	30	70
AM – 104	Numerical Analysis	4	--	4	30	70	--	--	30	70
AM – 105	Mechanics	4	--	4	30	70	--	--	30	70
AM – 106	C++	4	4	4	18	42	12	28	30	70
	Total	24	04	28	168	392	12	28	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
AM – 201	Complex Analysis	4	--	4	30	70	--	--	30	70
AM – 202	Partial Differential Equations	4	--	4	30	70	--	--	30	70
AM – 203	Functional Analysis	4	--	4	30	70	--	--	30	70
AM – 204	Fluid Dynamics	4	--	4	30	70	--	--	30	70
AM – 205	Modeling And Simulation	4	--	4	30	70	--	--	30	70
AM – 206	Mathematical Software	4	4	4	18	42	12	28	30	70
	Total	24	04	28	168	392	12	28	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
AM – 301	Theory of Algorithm	4	--	4	30	70	--	--	30	70
AM – 302	Integral Equation	4	--	4	30	70	--	--	30	70
AM – 303	Optimization	4	--	4	30	70	--	--	30	70
AM – 304	Advanced Analysis	4	--	4	30	70	--	--	30	70
AM – 305	Computational Fluid Dynamics	4	--	4	30	70	--	--	30	70
AM – 306	Applied Statistics	4	4	4	18	42	12	28	30	70
	Total	24	04	28	168	392	12	28	180	420

**Semester – IV**

Subject Code	Subject	Scheme Of Teaching			Scheme Of Examination					
		L	P	Total	Th.		Pr.		Total	
					Int	Ext	Int	Ext	Int	Ext
AM – 401	Image Processing	4	--	4	30	70	--	--	30	70
AM – 402	Wavelet Analysis	4	--	4	30	70	--	--	30	70
AM – 403	Digital Signal Processing	4	--	4	30	70	--	--	30	70
AM – 404	Fuzzy Modeling	4	--	4	30	70	--	--	30	70
AM – 405	Advanced Optimization	4	--	4	30	70	--	--	30	70
AM – 406	Practical based on Matlab	--	4	4	--	--	30	70	30	70
	Total	20	04	24	150	350	30	70	180	420

## AM 101: Real Analysis

Syllabus to be offered at M. Sc. Applied Mathematics Sem - I w.e.f. June 2010-11

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.

## **AM 102: Ordinary Differential Equations**

**Syllabus to be offered at M. Sc. Applied Mathematics Sem - I w.e.f. June 2010-11**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

- Mathematical modeling by means of ordinary differential equations
- Reduction of nth order equation into first order systems
- Existence and uniqueness of solution of a nonlinear system of ordinary differential equations, Lipschitz condition, Gromwell's lemma.
- Phase plane Analysis
- Linearization of nonlinear systems
- Autonomous and non-autonomous linear system Theory: Linear Dependence and independence of solution, Wronskian.
- Transition matrix (fundamental matrix) for a linear system, solution of a nonlinear system by variation of parameters method, computation of transition matrix , eigenvalue method, Peano-Backer series method.
- Discrete dynamical systems
- Stability of dynamical systems, Lyapunov, exponential and asymptotic stability and their characterization.
- Sturm -Liouville equations, Eigenvalue problems

### **References:**

1. S.L. Ross: Differential equations, Blasdell publishing company, First edition, 1964
2. Birkhoff G and Rota G.C.: Ordinary differential equations, Boston, 1962
3. Coddington E. A and N. Levinson: Theory of ordinary differential equations, McGraw-Hill, New York, 1955.
4. Saber N. Elaydi: An introduction to Differential Equations, Springer-verlag, Second edition, 1995
5. Arnold V.I: Ordinary Differential Equations, Prentice- Hall of India,

## AM 103: Linear Algebra

Syllabus to be offered at M. Sc. Applied Mathematics Sem - I w.e.f. June 2010-11

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

Basics of inner product space, orthogonal sets Fourier coefficients and partial identity gram-Schmidt process QR factorization, approximation and orthogonal projection, equivalence of the problems, normal equations projection operators, orthogonal complements, applications to an approximations and matrix theory fredholm alternative theory, matrix representation of an inner products, orthogonal change of bases, rank of gram matrix

### Diagonalizable linear operators

eigen values and eigen vectors, spectrum and eigen spaces of an operator, theoretical computation using determents, property of the characteristic polynomial, geometric and algebraic multiplicity,

### References:

1. J. T. Scheick, Linear algebra with application, Mc- Hill international addition, 1997.
2. Krishnamurthy, Mainra & Arora : An Introduction to Linear Algebra, Affiliated East-West Press Pvt. Ltd., N.Delhi.
3. I. H. Sheth : Linear Algebra, Nirav Prakashan.
4. S. Kumaresan : Linear Algebra, Prentice Hall of India, 2000.
5. Serge Lang : Linear Algebra, Addition-Wesley Pub. Co.(Student Ed.).
6. Balakrishnan : Linear Algebra, Tata-McGraw Hill Ed.

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## **AM 104: Numerical Analysis**

**Syllabus to be offered at M. Sc. Applied Mathematics Sem - I w.e.f. June 2010-11**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

- Computer Arithmetic: Floating point numbers and round off errors, Absolute and relative errors.
- Polynomial Interpolation: Hermit's interpolation formula with error analysis, Richardson interpolation, splines and spline interpolation, Aitken extrapolation
- Numerical differentiation, Gaussian quadrature, Romberg integration, adaptive quadrature
- Solution of system of Linear equations:
  - Matrix inversion, Jordan's method.
  - The LU and Cholesky factorizations
  - Pivoting and constructing an algorithm based on Gaussian elimination method
  - Solution of equations by iterative methods (Jacobi's method, Gauss-Seidel method)
- Algebraic Eigen value problem :
- Properties of eigen values and eigen vectors
- Power method
- Inverse power method
- Jacobi's method, Given's method
- Schur and Gershgorins theorem
- Numerical Solution of ODE: single step method-Runge Kutta methods, Multistep method - Milne Simpson's method.
- System of non linear equations: Newton Raphson's method

**References:**

1. C.E. Froberg: Introduction to Numerical Analysis, Addison Wesley Publishing Company, sixth edition, 1981.
2. S.S. Sastry: Introductory Methods of Numerical Analysis, Prentice Hall of India, New Delhi, 1997.
3. E.V. Krishnamurthy and S.K.Sen: Computer based numerical Algorithms, East – West press Pvt. Ltd. 1976
4. M.K. Jain: Numerical analysis for scientists and Engineers, New Age International Ltd. Publishing, 1992

## AM 105: Mechanics

Syllabus to be offered at M. Sc. Applied Mathematics Sem - I w.e.f. June 2010-11

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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## **AM 106: C++**

**Syllabus to be offered at M. Sc. Applied Mathematics Sem - I w.e.f. June 2010-11**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>4</b>

### **Introduction**

Algorithms and Flowchart, Types of Languages, Introduction to C Language

### **C Fundamentals**

Identifiers, Data Types, Constants and Variables, Arrays

### **Operators and Expressions**

Arithmetic Operators, Unary Operators, Relations Operators, Logical Operators  
Assignment Operators, Conditional Operators, Library Functions, Expressions,  
Evaluation of Expression

### **Data Input and Output**

Single Character input and output, The scanf function, The printf function, Gets  
and Puts functions

### **Control statements**

The While Statement, do-while statement, for statement, if – else statement,  
switch statement, break statement, continue statement, goto statement

### **Functions**

Introduction to functions, Function definition, Accessing function, Passing  
arguments to function, Recursive function

### **Arrays**

Defining an array, Processing an array, Multi dimensional arrays, Passing array to  
a function, Arrays and Strings

### **Structures and Unions**

Defining a structure, Processing a structure, Unions

### **References:**

1. C++ programming Language – karnighan & Ritchie – TMH
2. 'C++' Odyssey 6<sup>th</sup> Volume – Vijay Mukhi – PHI
3. Programming in 'C++' – Stephan Kochan – CBS
4. Mastering turbo C++- Kelly and Bootle – BPB
5. C++ language Programming Byron Gottfried – TMH

## AM 201: Complex Analysis

Syllabus to be offered at M. Sc. Applied Mathematics Sem - II w.e.f. June 2010-11

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-Goursat Theorem, Homotopy version of Cauchy's theorem, Morera'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, Addison 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.

## **AM 202: Partial Differential Equations**

**Syllabus to be offered at M. Sc. Applied Mathematics Sem - II w.e.f. June 2010-11**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

- Introduction to PDE, Modelling Problems related to PDE.
- General PDE, Classification of PDE -hyperbolic, elliptic and parabolic PDE
- Boundary conditions, well-posed problem, The Cauchy-Kowalewski theorem for existence and uniqueness of solutions to PDE
- **Hyperbolic PDE**
  - Scalar first order Partial differential equations, Characteristics, Charpits method, Weak Solutions., Quasi-linear first order equations and quasi-Linear systems of partial differential equations, weak solutions, shocks and refractions, Burgers equation, Non-uniqueness and entropy conditions.
- **Elliptic PDE**
  - Solution of Laplace equation using separable variable technique, fundamental solution, Mean value theorem., Strong Maximum Principle, uniqueness and regularity, Energy Methods,
- **Parabolic PDE**
  - Solution of Heat equation using Fourier Transform method, Mean Value Theorem, Maximum Principle, Regularity, Uniqueness.

### **References:**

1. Strauss W. A: Partial differential equations, An Introduction, Wiley, John and sons 1992.
2. Renardy and Rogers: An introduction to PDE's, Springer-Verlag, 1999.
3. Smoller: Shock Waves and reaction-diffusion equations, second edition, 1994.
4. Kevorkian: Partial Differential equations, Wadsworth and Brooks/ cole
5. F.John: Partial differential equations McGraw-Hill, New-york,

## AM 203: Functional Analysis

Syllabus to be offered at M. Sc. Applied Mathematics Sem - II w.e.f. June 2010-11

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 linear 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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## **AM 204: Fluid Dynamics**

**Syllabus to be offered at M. Sc. Applied Mathematics Sem - II w.e.f. June 2010-11**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

- 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

# AM 205: Modeling & Simulation

Syllabus to be offered at M. Sc. Applied Mathematics Sem - II w.e.f. June 2010-11

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

## References:

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. Jerry Banks, John S., Carson II, Barry Nelson and David M.Nicol,:Discrete – Event system simulation , Prentice hall, 2001

## AM 206: Mathematical Software

Syllabus to be offered at M. Sc. Applied Mathematics Sem - II w.e.f. June 2010-11

L	T	P
4	1	4

### 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, comment, 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

### References:

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

## AM - 301 Theory of Algorithm

Syllabus to be offered at M. Sc. Applied Mathematics Sem - III w.e.f. June 2010-11

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

- Logic

Propositional and predicate logic, propositions, predicates and quantifiers, quantifier and logical operators, rules of inference, methods of proof and logical verification of computer programs.

- Theory of algorithms

Problems and instances algorithms, characteristics of algorithms, concepts of test data, efficiency of algorithms, theoretical, empirical and hybrid approaches to measure efficiency, time complexity, space complexity, asymptotic notations, solving recurrences using characteristics equations, examples of simple algorithm and their analysis

- Graph theoretic algorithms and computer programs

Recap the concepts and definitions of graph and trees as data structure , some basic algorithms, representation of graphs, breath first search, topological search, heap sort algorithm connectedness and assumptions, Lattice theory, Boolean algebra

### References:

1. Harry R. Lewis and Christosh H. Papadimitriou. Elements of the theory of computation, Prentice Hall of India. 1996
2. V.Aho, J.E.Hopcroft and J.D. Vilman The design and analysis of Computer algorithms. 1974
3. Thomas H. Cormen Leiserson and Rivest Introduction to algorithm, Prentice Hall of India, 1998
4. Dino Mandrioli, Carlo Ghezzi : Theoretical foundations of computer science, John-Wiley and sons, 1987

## AM – 302: Integral Equations

Syllabus to be offered at M. Sc. Applied Mathematics Sem - III w.e.f. June 2010-11

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

### Variational problems with fixed boundary

The concepts of variational parameter, and its properties, variational forms of functional form, function depends on Higher order derivatives, functionals dependent on function of several independent variables, variational problem in parametric forms, application to the problems of mechanics, variational problems leading to an integral equation or differential difference equations, theorem of Dubois' Reymond stochastic calculus of variation,

### Variational problem with moving boundary

Functional of the form  $I(y(x)) = \int_{x_1}^{x_2} F(x, y, y') dx$ , variational problem with a moveable

boundary for a functional dependent on two function, one sided variation, reflection and refraction of extremals, diffraction of light rays

### References:

1. A. S. Gupta, calculus of variation with applications, prentice-hall India, 1997.
2. J. David Logan, applied mathematics, john wiley and sons, 1997.

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## **AM - 303: Optimization**

**Syllabus to be offered at M. Sc. Applied Mathematics Sem - III w.e.f. June 2010-11**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

- Optimization problems in engineering and industries
- Optimization problem formulation
- Classification of optimization problem
- Transportation problem,
- Assignment problem
- Replacement theory
- Sequencing problem
- Multistage optimization problems
- Dynamic programming problems techniques
- Project scheduling problems : bar charts, mile stone charts, Fulkerson's rule, Critical Path Method(CPM), project evaluation and review techniques (PERT)
- Queuing theory

**References:**

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

## AM – 304 Advanced Analysis

Syllabus to be offered at M. Sc. Applied Mathematics Sem - III w.e.f. June 2010-11

L T P

4-1-0

### **Fundamental Theorems for Normed and Banach Spaces:**

Zorn's Lemma, Hahn-Banach Theorem, Hahn-Banach Theorem for Complex Vector Spaces and Normed Spaces, Application to Bounded Linear Functionals on  $C[a,b]$ , Adjoint Operator, Reflexive Spaces, Category Theorem. Uniform Boundedness Theorem, Strong and Weak Convergence, Convergence of Sequences of Operators and Functionals, Application to Summability of Sequences, Numerical Integration and Weak\* Convergence, Open Mapping Theorem, Closed Linear Operators. Closed Graph Theorem,

### **Further Applications : Approximation Theory:**

Approximation in Normed spaces, Uniqueness, Strict Convexity, Uniform Approximation, Chebyshev Polynomials, Approximation in Hilbert Space, Splines,

### **Spectral Theory of Linear Operators in Normed Spaces:**

Spectral Theory in Finite Dimensional Normed Spaces, Basic Concepts, Spectral Properties of Bounded Linear Operators, Further Properties of Resolvent and Spectrum, Use of Complex Analysis in Spectral Theory, Banach Algebras, Further Properties of Banach Algebras.

### **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.

## **AM - 305: Computational Fluid Dynamics**

**Syllabus to be offered at M. Sc. Applied Mathematics Sem - III w.e.f. June 2010-11**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

- 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.

### **References:**

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.

## AM - 306: Applied Statistics

Syllabus to be offered at M. Sc. Applied Mathematics Sem - III w.e.f. June 2010-11

L	T	P
4	1	0

- **Probability :**

Basic concepts, Sample space, Discrete probability ,Simple theorems on probability, Independence of events, Bayes theorem. Discrete and continuous random variable, Binomial, Poisson and Normal distributions, expectation and moments, Chebyshev's inequality, central limit theorem.

- **Statistics:**

Data analysis , measures of central tendency, measures of dispersions, curve fitting, regression, correlation, chi-square test of goodness of fit, contingency tables, confidence interval for mean , variance.

control charts for variables and attributes, acceptance sampling by attributes, simple, double and sequential sampling plans, Design of experiments

### **References:**

1. Berry and Lindgren: Statistics theory and methods , second edition, Duxburg, Boston, 1996
2. Hastings: Probability and statistics, Addison Wesley Longman, Boston, 1997.
3. Hogg and Tannis: Probability and Statistical inference, sixth edition, Prentice-Hall, Upper Saddle River, New Jersey, 2000
- 4 S.C.Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan chand and sons, 2000
5. S.,P.Gorden and F.S. Gorden: Contemporary Statistics, a computer approach, 1994

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## **AM - 401 Image Processing**

Syllabus to be offered at M. Sc. Applied Mathematics Sem - IV w.e.f. June 2010-11

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

### **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 Acquisition, 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),

### **References:**

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

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## AM - 402 Wavelet Analysis

Syllabus to be offered at M. Sc. Applied Mathematics Sem - IV w.e.f. June 2010-11

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

- 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

### **References:**

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.

## AM 403: Digital Signal Processing

Syllabus to be offered at M. Sc. Applied Mathematics Sem - IV w.e.f. June 2010-11

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 Bandlimited 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, Multirate 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 “multirate Digital Signal Processing” Pearson education 2006
3. oppenheim A. V., Schafer, “Digital Signal Processing” Pearson education 2006

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## **AM 404: Fuzzy Modeling**

Syllabus to be offered at M. Sc. Applied Mathematics Sem - IV w.e.f. June 2010-11

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

### **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

## **AM 405: Advanced Optimization**

**Syllabus to be offered at M. Sc. Applied Mathematics Sem - IV w.e.f. June 2010-11**

<b>L</b>	<b>T</b>	<b>P</b>
<b>4</b>	<b>1</b>	<b>0</b>

- Classical optimization techniques : Single variable optimization, Multivariable optimization, Constraint optimization, Lagrangian multiplier method, Kuhn-Tucker conditions
- Single variable optimization techniques:
  - Bracketing method - Exhaust search
  - Region elimination method - Interval halving method, Golden section method
  - Interpolation method - Quadratic interpolation method
  - Gradient base methods - Newton-Raphson method, bisection method
- Multivariable optimization techniques:
  - Univariate method
  - Direct Search method - Simplex search method, Powells conjugate direction method
  - Constraint linear optimization problem
  - Overview of linear optimization problem
  - Quadratic programming - Wolf's modified simplex method, Bailes methods
  - Integer programming problem - Gomorys cutting plane method, branch and bound techniques

### **References:**

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 ,2<sup>nd</sup> edition ,1975.

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## **AM 406: Practical based on Matlab**

Syllabus to be offered at M. Sc. Applied Mathematics Sem - IV w.e.f. June 2010-11

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<b>0</b>	<b>1</b>	<b>4</b>

- **Practical based on Image processing using Matlab**
- **Practical based on Wavelet using Matlab**
- **Practical based on Digital Signal Processing using Matlab**

### **References:**

1. Chapman Stephen: Matlab programming for engineers, Thompson learning, 2004.
2. krishnamurthy E. V. and Sen S. K. "Programming in Matlab" East – West Press 2003
3. Rudra Pratap: getting started with Matlab, oxford university press, 2004