

**VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT**

**M.Sc. Applied Mathematics**

**Scheme of Teaching and Examination**

**First Year (w.e.f. 2009-2010)**

Subject Code	Subject	Scheme Of Teaching			Scheme Of Examination					
		L	P	Total	Th.		Pr.		Total	
					Int	ext	Int	Ext	Int	Ext
AM – 101	Real & Complex Analysis	4	--	4	30	70	--	--	30	70
AM – 102	Ordinary Differential Equations	4	--	4	30	70	--	--	30	70
AM – 103	Applied Linear Algebra	4	--	4	30	70	--	--	30	70
AM - 104	Functional Analysis	4	--	4	30	70	--	--	30	70
AM – 105	Numerical Analysis	4	--	4	30	70	--	--	30	70
AM – 106	Basic Fluid Dynamics	4	--	4	30	70	--	--	30	70
AM – 107	Practical Using Matlab	--	4	4	--	--	30	70	30	70
	Total	24	04	28	180	420	30	70	210	490

**Second Year (w.e.f. 2010-2011)**

Subject Code	Subject	Scheme Of Teaching			Scheme Of Examination					
		L	P	Total	Th.		Pr.		Total	
					Int	ext	Int	Ext	Int	Ext
AM – 201	Partial Differential Equations	4	--	4	30	70	--	--	30	70
AM – 202	Mathematical Modeling Of Dynamical System	4	--	4	30	70	--	--	30	70
AM – 203	Digital Image Processing and Discrete Time Signal Processing	4	--	4	30	70	--	--	30	70
AM – 204	Neural Network and Fuzzy Logic	4	--	4	30	70	--	--	30	70
AM – 205	Optimization Technique	4	--	4	30	70	--	--	30	70
AM – 206	Mathematical Statistics	4	--	4	30	70	--	--	30	70
AM - 207	Matlab Toolbox	--	4	4	--	--	30	70	30	70
	Total	24	04	28	180	420	30	70	210	490

# AM 201: Partial Differential Equations

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

L	T	P
4	1	0

- 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, Wave equation
- **Elliptic PDE**
- Solution of Laplace equation using separable variable technique, fundamental solution, Mean value theorem., Strong Maximum Principle, uniqueness and regularity, Energy Methods, Sobolev spaces and Lax-Milgram lemma.
- **Parabolic PDE**
- Solution of Heat equation using Fourier Transform method, Mean Value Theorem, Maximum Principle, Regularity, Uniqueness., Semigroup approach

## 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,

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## AM 202: Mathematical modeling of Dynamical System

Syllabus to be offered at M. Sc. Applied Mathematics year - II w.e.f.  
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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

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

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## **AM - 203 Digital Image Processing and Discrete - Time Signal Processing**

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L	T	P
4	1	0

### **Introduction**

Fundamentals of Image Processing, Applications of Image Processing, Automatic Visual Inspection System, Remotely Sensed Scene Interpretation, Biomedical Imaging Techniques, Defense surveillance, Content-Based Image Retrieval, Moving-Object Tracking, Image and Video Compression, Human Visual Perception, Human Eyes, Neural Aspects of the Visual Sense, Components of an Image Processing System, Digital Camera

### **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

### **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), Karhunen-Loeve Transform or Principal Component Analysis, Covariance Matrix, Eigenvectors and Eigenvalues, Principal Component Analysis, Singular Value Decomposition

### **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. Tinku Acharya & Ajoy K. Ray, 'Image Processing ,Principles and Applications' WILEY- INTERSCIENCE
2. Gonzalez & Woods, "Digital image processing" Pearson Education second edition
3. oppenheim A. V., Schafer & Buck "Discrete Time Signal Processing" Pearson education 2006
4. crochiere & rabiner "multirate Digital Signal Processing" Pearson education 2006
5. oppenheim A. V., Schafer, "Digital Signal Processing" Pearson education 2006

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## **AM 204: Neural Network and Fuzzy Logic**

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L	T	P
4	1	0

- 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 Unsupervised 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.

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

### **The theory of approximating reasoning**

Primary elements of the AR system, semantics of the AR system, Deduction in AR, minimal solution and projections, binary logic in AR, functional representations

### **Introduction to fuzzy logic control**

Basic concepts, basic reasoning algorithm, on the relationship to PI, PD, and PID control, design of FLC, extension of the FLC

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

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## AM 205: Optimization Technique

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L	T	P
4	1	0

- General Constraint optimization problem:
- Direct search method
- Random search method
- Complex search method
- Montc Carlo method
- Penelty function method(Interior and Exterior)
- Sequential linear Programming techniques(Frank-Wolfe method)
- Feasible direction methods-Gradient projection method
- Augmented Lagrangian method
- Non traditional optimization algorithms
- Genetic algorithms
- Simulated annealing methods
- 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)

**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 - 206: Mathematical Statistics

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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. One population case, two population case, testing of hypotheses, small samples and large samples, sampling techniques, Simple random sampling with and without replacement, stratified sampling.

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

- **Stochastic processes:**

Markov chains with finite and countable state space, classification of states, limiting behavior of n-step transition probabilities, Continuous Markov process.

**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 207: Matlab Toolbox

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L	T	P
0	1	4

- Practical based on Image processing using Matlab toolbox
- Practical based on Neural Network using Matlab toolbox
- Practical based on Digital Signal Processing using Matlab toolbox
- Practical based on Fuzzy Logic using Matlab toolbox

### 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