B.S. Abdur Rahman Crescent Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956
GST Road, Vandalur, Chennai 600 048

Ph.D. MATHEMATICS

CURRICULUM AND SYLLABI

Course Code	Course Title	L	T	P	C
MA 711	Research Methodology	4	0	0	4
	Elective – I	3	0	0	3
	Elective – II	3	0	0	3
	Elective – III	3	0	0	3
		13	0	0	13

Electives					
Course Code	**Course Title**	**L**	**T**	**P**	**C**
MA751	**Discrete Mathematics**	**3**	**0**	**0**	**3**
MA752	**Advanced Numerical Methods**	**3**	**0**	**0**	**3**
MA753	**Theory of computation**	**3**	**0**	**0**	**3**
MA754	**Stochastic Processes**	**3**	**0**	**0**	**3**
MA755	**Continuum Mechanics**	**3**	**0**	**0**	**3**
MA756	**Optimization Techniques**	**3**	**0**	**0**	**3**
MA757	**Finite Element Methods**	**3**	**0**	**0**	**3**
MA758	**Fluid Mechanics**	**3**	**0**	**0**	**3**
MA759	**Algorithms**	**3**	**0**	**0**	**3**
MA760	**Epidemiology**	**3**	**0**	**0**	**3**
MA761	**Bio Statistics**	**3**	**0**	**0**	**3**
MA762	**Mathematical Logic**	**3**	**0**	**0**	**3**
MA763	**Advanced Analysis**	**3**	**0**	**0**	**3**
MA764	**Geometric Function theory**	**3**	**0**	**0**	**3**
MA765	**Differential Geometry**	**3**	**0**	**0**	**3**
MA766	**Graph Theory**	**3**	**0**	**0**	**3**
MA767	**Fuzzy Mathematics**	**3**	**0**	**0**	**3**
MA768	**Operations Research**	**3**	**0**	**0**	**3**
MA769	**Essential Mathematical Biology**	**3**	**0**	**0**	**3**
MA770	**Cellular Automata**	**3**	**0**	**0**	**3**
MA771	**Mathematical Elements for Computer Graphics**	**3**	**0**	**0**	**3**
MA772	**Mathematical Modeling And Simulation**	**3**	**0**	**0**	**3**
MA773	**Inventory Control and Queuing theory**	**3**	**0**	**0**	**3**
MA774	**Genetic algorithms**	**3**	**0**	**0**	**3**
MA775	**Neural networks**	**3**	**0**	**0**	**3**
MA776	**Advanced Mathematics**	**3**	**0**	**0**	**3**
MA777	**Financial Mathematics**	**3**	**0**	**0**	**3**

MA711 Research Methodology

L	T	P	C
4	0	0	4

UNIT- I (9+3)

Articles – survey, popular, technical – Format of a thesis – Subject classification

UNIT- II (9+3)

American Mathematical Society – Review technique – Abstract – Research in Mathematics – prizes, medals, magazines

UNIT- III (9+3)

Referencing – Bibliography – Preparation of thesis and dissertation – Document preparation – Dissertation – Software – Free software, commercial, shareware, google, latex

UNIT- IV (9+3)

Mathematical and Statistical society – Impact factor – Citation index – Search engines – commercial technique of choice used in solving PDE – method of generating functions – Simulation

UNIT- V (9+3)

Mathematical software : MATHEMATICA, MATLAB

Total: (45+15=60 Hrs)

Reference:

1. C. R. Kothari , "*Research Methodology Methods and Techniques* " – Second Edition ,Wishwa Prakasham Publishers
2. Ranjit Kumar " *Research Methodology : A step by step Guide to Beginners*"Sage Publications, (2005)
3. Suresh C.Sinha and Anil K. Dhiman " *Research Methodology* " Ess Ess Publication 2005
4. Stephen Wolfram *" The Mathematica Book* " 5th edition , , Wolfram Media 2003
5. Duane C. Hanselman " Mastering Matlab 7.0" 1st Edition, Prentice Hall, NY, (2004)

MA 751 Discrete Mathematics

L	T	P	C
3	0	0	3

UNIT- I (9 Hrs)
Permutations and combinations and basic definitions.

UNIT- II (9 Hrs)
Generating functions. Polya‟s enumeration theory.

UNIT- III (9 Hrs)
Recurrence relations, Principle‟s of inclusion and exclusion.

UNIT- IV (9 Hrs)
Balanced incomplete block design. Difference sets. System of distinct representatives.

UNIT- V (9 Hrs)
Mathematical software : MATHEMATICA, MATLAB

Total: 45 Hrs

Reference:

1. J.P. Tremblay and R. Manohar, “Discrete Mathematical Structures with Applications to Computer Science”, McGraw Hill Companies Limited, New York,
   1997
2. Korfhage R.R., “Discrete Computation Structures”, 2nd Edition Academic Press.
3. BirkhoftG. and Bartee T.C., “Modern Applied Algebra”, McGraw Hill. 1970
4. Johnson Baugh, “Discrete Mathematics”, Dorling Kindersley (India) Pvt Ltd. 2008

MA752 Advanced Numerical Methods **L T P C**
3 0 0 3

UNIT I (9 Hrs)
Numerical Linear Algebra: Triangular form, Matrix norms, Conditioning of linear systems, Direct methods (Gauss, Cholesky, Householder), Iterative methods (Jacobi, Gauss-Seidel, Relaxation) for solving linear systems.

UNIT II (9 Hrs) Computing of eigenvalues & eigen-vectors (Jacobi, Givens-Householder, Q-R, Inverse methods), Conjugate gradient method & its preconditioning.

UNIT III (9 Hrs) Numerical Solution Of Ordinary Differential Equations :Introduction. Runge-Kutta methods -derivation, error bounds and error estimates. Weak stability theory for Runge-Kutta Methods.

UNIT IV (9 Hrs) Numerical Solution Of Partial Differential Equations: Parabolic equations in one and two space dimensions - explicit and implicit formulae. Consistency, stability and convergence. Elliptic Equations - Dirichlet, Neumann and mixed problems.

UNIT V (9 Hrs) Direct factorization methods and successive over-relaxation (S.O.R.). Hyperbolic equations. First order hyperbolic systems in one and two space dimensions-stability and convergence. Second order equations in one and two space dimensions. The Galerkin method.

Total: (45 Hrs)

References:

1. James M.Ortega and Andrew S.Grimshaw., An Introduction to C++ and Numerical Methods, Oxford University Press, New York, 1999
2. Jain M K, Iyengar S R K, Jain R K., Numerical Methods for Scientific and Engineering Computation, Second Edition, Wiley Eastern Ltd, New Delhi.
3. Froberg C E., Introduction to Numerical Analysis, Second Edition, Addison-WesleyPublishing Company, 1972.

MA 753 Theory of computation **L T P C**
3 0 0 3

UNIT I (9 Hrs)
Some fundamental proof techniques. Finite Automata: Finite automata and regular languages, Languages that are and are not regular.

UNIT II (9 Hrs) Algorithm aspects of finite automata. Context-free grammars: Push-down automata, Languages that are and are not context-free, Algorithms for context-free grammars.

UNIT III (9 Hrs) Basic Turing machine model and Turing computability: Variants of Turing machines. Grammars and Turing machines.

UNIT IV (9 Hrs)
Primitive recursive functions, μ-recursive functions and Turing computability. Church-Turing thesis and Universal Turing machines: Halting problem,

UNIT V (9 Hrs) Some undecidable problems. Time-bounded Turing machines: Classes P and NP, NP-completeness, Examples of NP-complete problems, The time hierarchy.

Total: (45 Hrs)

References:

1. John E.Hopcroft and Jeffrey D.Ullman, Introduction to Automata Theory, Languages and Computation, Narosa Publishing House, New Delhi, 1995.
2. H.R.Lewis and C.H.Papadimitriou, “Elements of The theory of Computation”, Second Edition, Pearson Education/PHI, 2003
3. J.Martin, “Introduction to Languages and the Theory of Computation”, Third Edition, TMH, 2003.
4. Micheal Sipser, “Introduction of the Theory and Computation”, Thomson Brokecole, 1997.

MA754 **Stochastic Processes** **L T P C**
3 0 0 3

UNIT –I (9 Hrs)
Elements of Stochastic processes – simple examples, Classification of general stochastic processes- Stationary independent increment process- Properties.

UNIT –II (9 Hrs) Markov Chains – discrete in time. Examples. Classification of states of a Markov Chain. Recurrence. Basic limit theorem of Markov Chains. Absorption probabilities. Criteria for recurrence.

UNIT-III (9 Hrs) Markov Chains continuous in time. Examples. General Pure birth process, Poisson process, Birth and Death process- Finite state continuous time Markov Chains-Bivariate Poisson process.

UNIT –IV (9 Hrs) Renewal process – Definition and examples, Elementary Renewal Theorem, Martingales
– Examples. Super and Sub -martingales.

UNIT –V (9 Hrs) Branching process – generating function relations, estimation probabilities, two – type branching process – Description of continuous time branching process. Stationary process – mean square distance, prediction and covariance stationary process.

References: Total (45Hrs)

1. Bartholomew “Stochastic models for Social processes”. John Wiley and Sons Ltd, London. (1973).
2. Cinlar, E “Introduction to Stochastic Processes”. Prentice – Hall, Inc. New Jersey (1975).
3. Cox, D.R. and Miller, H.D. “ Theory of Stochastic Processes “ 3rd edition Chapman and Hall, London (1965).
4. J Medhi “ Stochastic Processes”, 3rd edition , New Age International, India
5. S. M .Ross “ Stochastic Processes” John Wiley & sons, 1996

MA755 Continuum Mechanics **L T P C**

3 0 0 3

UNIT-I (9 Hrs)

Introduction to tensors. Stress tensor. Equilibrium equations. Mohr‟s circle for plane stress.

UNIT-II (9 Hrs) Deformation, Strain tensor, Rate of deformation tensor. Equations of motion. Dynamic similarity.

UNIT-III (9 Hrs) Exact solutions. Laminar boundary layer over a float plat. Vorticity circulation & irrational flow.

UNIT-IV (9 Hrs)

Torsion of cylindrical bars, Plane elastic waves.

UNIT- V (9 Hrs)

Elasticity : Hookes‟ law :The general equation of linear elasticity: Energy theorem, duality, variational formulations.

Total (45 Hrs)

Reference:

1. J.H Heinbockel, “Introduction to Tensor Calculus and continuum Mechanics”, Trafford Publishers .2001
2. Roger Teman , Alain Miranville “ Mathematical Modeling in linear Elasticity” ,2nd Edition , Cambridge university Press.
3. Sokolnikoff I S., “Mathematical Theory of Elasticity” McGraw Hill (1983)

MA756 Optimization Techniques **L T P C**
3 0 0 3

UNIT-I (9 Hrs)

Elements of the DP Model: The Capital Budgeting - More on the Definition of the state - Examples of DP models and computations - Problem of Dimensionality in Dynamic programming - Solution of Linear programs by Dynamic programming.

UNIT-II (9 Hrs) Decisions under Risk - Decision Trees - Decisions Under Uncertainty – Game Theory.

UNIT- III (9 Hrs)

The ABC Inventory System - Generalized Inventory Models – Deterministic Models – Just-in-Time (JIT) manufacturing system.

UNIT- IV (9 Hrs)

Role of Poisson and Exponential Distribution – Processes: Birth and Death - Queues with Combined Arrival and Departures - Non-Poisson Queues – Queues with Priorities for Service - Random or Series Queues.

UNIT-V (9 Hrs)

Unconstrained Extremal Problems - Constrained Extremal Problems – Nonlinear Programming Algorithm - Unconstrained Nonlinear Algorithms - Constrained Nonlinear Algorithms.

Total (45 Hrs)

References:

1. H.A.Taha “Operations Research - An Introduction” (Fifth Edition), Prentice Hall of India (P) Limited, New Delhi, 1996.
2 D. Phillips, A. Ravindran, Solberg, “Operations Research: Principals and Practice”, John Wiley & Sons (1976).
3. S.S.Rao, “Engineering Optimization, (3rd Edition) New Age International (p) Ltd, New Delhi , 1996

MA757 **Finite Element Methods** **L T P C**

3 0 0 3

UNIT I (9 Hrs)

Introduction and motivation, Weak formulation of BVP and Galerkin approximation.

UNIT II (9 Hrs)

Piecewise polynomial spaces and finite element method, Computer implementation of FEM

UNIT III (9 Hrs)

Results from Sobolev spaces, Variational formulation of elliptic BVP.

UNIT IV (9 Hrs)

Lax-Milgram theorem, Estimation for general FE approximation, Construction of FE spaces, Polynomial approximation theory in Sobolev spaces.

UNIT V (9 Hrs) Variational problem for second order elliptic operators and approximations, Mixed methods, Iterative techniques.

Total: (45 Hrs)

References:

1. L.J. Segerlind, “Applied Finite Element Analysis”, (Second Edition) John Wiley & Sons, 1984
2. J.N. Reddy “ Introduction to Finite element Methods” 2nd edition, McGraw Hill Publishers 1993

MA 758 Fluid Mechanics **L T P C**
3 0 0 3

UNIT –I (9 Hrs)

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

UNIT –II (9 Hrs)

Euler‟s equation of motion – Bernoulli‟s theorems – Vorticity– Helmholtz vorticity theorem – two dimensional motion – stream function – complex potentials.

UNIT –III (9 Hrs) Complex potentials of sources – sinks – doublets – circle theorem – Blasius theorem – image of a source and a doublet on the circular cylinder – uniform stream past the circular cylinder.

UNIT –IV (9 Hrs) Axisymmetric flow – Stoke‟s stream function – Butler‟s sphere theorem – sphere in a uniform stream – sphere in a uniform stream – Joukowski transformation – Theorem of Kutta and Joukowski – Lift of an aerofoil.

UNIT –V (9 Hrs) Navier – Stoke‟s equation of motion – some exact solutions of Navier-Stokes equations

– flow between parallel plates –flow through a circular tube – flow between concentric cylinders– flow through a pipe of elliptical cross section – equilateral triangle cross section – flow through annulus.

Total (45 Hrs)

References:

1. Milne Thomson, *Theoretical Hydrodynamics*, , Dover Publishing Co. 1996
2. Chorlton F., *Textbook of Fluid Dynamics*, CBS Publications, New Delhi (2004)
3. Schaum‟s series “Fluid Dynamics”, 3rd edition.Mc Graw Hill,
4. Batchelor, C.K., *An Introduction to Fluid Mechanics,* Cambridge University Press.(1967)

MA 759 Computer Algorithms **L T P C**
3 0 0 3

UNIT –I (9 Hrs)
Algorithm – Definition, Time Complexity. Elementary Data Structures – Stacks, Queues, Trees, Priority Queues, Heaps, Heapsort, Graphs.

UNIT –II (9 Hrs)
Divide and Conquer – General method, Binary search, Merge sort, Quick sort

UNIT –III (9 Hrs)
The Greedy Method – Knapsack problem, Job sequencing with dead lines, Optimal storage on tapes, Optimal merge patterns.

UNIT –IV (9 Hrs) Basic traversal – Inorder, preorder, postorder traversals, Breadth first search and traversal, Depth first search and Traversal Backtracking – Sum of subsets, *n*-Queens
problem (*n* = 4, 8).

UNIT -V (9 Hrs)
NP – Hard and *NP* – complete problems – Basic Concepts, Cook‟s Theorem ,Conjunctive Normal Form(CNF) – satisfiability reduces to Clique Decision Problem(CDP), The Clique Decision Problem(CDP) reduces to The Node Cover Decision Problem

Total (45Hrs)

References:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, „Fundamentals of Computer Algorithms‟, Galgotia Publications, 1998.
2. Thomas H.Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, „Introduction to Algorithms‟, Second Edition, Prentice Hall of India, 2004.
3. Alfred V.Aho, John E.Hopcroft and Jeffrey D.Ullman, „Data Structures and Algorithms‟, Addison-Wesley, 1983.
4. M. Gary and S. Johnson, „Computers and Intractability: A guide to theory of *NP* Completeness ‟. H. Freeman & Company, 1979.

MA 760 Epidemiology **L T P C**
3 0 0 3

Unit 1 (9 Hrs)

Measuring health and disease – Observational Epidemiology- experimental epidemiology – Potential errors in epidemiology

Unit – 2 (9 Hrs)

Cautions in Epidemiology –Preventions in epidemiology – Environmental and occupational epidemiology

Unit –3 (9 Hrs)

Nutrition epidemiology – Clinical Epidemiology – epidemiology and prevention

Unit – 4 (9 Hrs)

Experimental Studies - Cohort Studies – timing – Issues – Comparison – Special Types of Cohort Studies

Unit – 5 (9 Hrs)

Case Control Study – Bias - Confounding – random errors – Measure of Modification –

Total (45 Hrs)

Reference

1. R Bonita, R Beaglehole T kjellstorm " Basic Epidemiology " 2nd edition, World Health Organization

2, Keenthe J Rothman , Sander greenland Timothy L Lash " Modern epidemiology" 3rd edition, Lippincott Williams & wilkins, Philadelphia , 2008

3.Ann Aschengrau George R Siege " Essential of epidemiology in Public Health " Jones and Bartlett Publishers, CANADA, 2003

MA 761 Bio Statistics **L T P C**
3 0 0 3

UNIT –I (9 Hrs)
Confidence intervals- Prediction and Tolerance intervals- Distribution free intervals – Confidence intervals for other measures.
UNIT –II (9 Hrs)
Non parametric tests:- The wilcoxon test- Kruskal wallis test – Friedman test

UNIT –III (9 Hrs)
Analysis f categorical data: The 2 by s contingency table – the r by c contingency table – multiple 2by 2 contingency tables

UNIT –IV (9 Hrs) Life table methods : the product limit method – comparison of two survival distributions **UNIT –V** (9 Hrs) Simple, multiple, ordered, conditional logistic regressions – Proportional hazard regressions. Total (45 Hrs)

References:

1. R.N. Forthofer , E.S. Lee and M. Hernandez " Bio Statistics, "Academic Press, California 1997
2. A.K Sharma " A text book of Bio Statistics" , Discovery Publishing House , Delhi, 2005

MA 762 Mathematical Logic **L T P C**
3 0 0 3

UNIT-I (9 Hrs)
Propositional calculus, Set theoretic concepts; Truth on algebraic systems; The calculus of predicates;

UNIT-II (9 Hrs)
Model theory; Proof Theory; Algorithms and recursive functions, Touring Mechines

UNIT-III (9 Hrs)
Classical Propositional Logic - Deduction Systems, Automatic Methods; Non - classical Propositional Logic - Intuitionistic Logic,

UNIT-IV (9 Hrs)
Normalization, Cut Elimination; Curry-Howard Correspondence; First Order Logic- Deduction Systems; Resolution; Tableaux Methods;

UNIT-V (9 Hrs)
Equality and Equational Logics; Type theory; Formalized Number Theory; Godel's Incompleteness Theorems.

Total (45Hrs)

Reference:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill Companies Limited, New York, 1997
2. Kenneth Rosen “Discrete Mathematical Structures” 5th Edition Tata Mc Graw Hill Publications.
3. D E Knuth , R L Graham “ Concrete Mathematics” Addition –Wesley , 1994

MA 763 Advanced Analysis **L T P C**
3 0 0 3

UNIT -I (9 Hrs)

Fourier Analysis: Haar measure and convolution – The dual group and Fourier Transform – Fourier Stieltjes transform – Positive definition functions – inverse theorem – Plancheral theorem – Pantryagin duality theorem – Bohr compactification – Characterization of $B(\Gamma)$ – Ordered groups – Theorem of F. and M. Riesz.

UNIT –II (9 Hrs) Wavelets: Ortho normal basis- Multi resolution analysis – Mother Wavelts, Yield
Wavelets- Shannon wavelets - Riesz bases and MRA – Franklin Wavelets- frames - Splines

UNIT -III (9 Hrs)

Compactness and convergence in the space of analytic functions ; The Space of Continuous , analytic functions and meromorphic functions – Riemann Mapping theorem – Weiertrass factorization theorem – Gamma function – Riemann‟s Zeta Function

UNIT -IV (9 Hrs) Transformation of Elliptic function – reduction of general problem – first and second principle of First degree equations – Landen‟s and Gauss‟s Transformation.

UNIT -V (9 Hrs) Spherical and Hyperbolic Metrics, Normal Convergence – Some classical theorems – Local Boundedness - Equicontinuity – Nevanlinna theorem - Ahlfors theory .

Total (45 Hrs)

References:

1. Walter Rudin, *Fourier analysis on groups*, Wiley & sons, 1990
2. Bachman, George; Narici, Lawrence; and Beckenstein, Edward. *Fourier and Wavelet Analysis.* New York: Springer-Verlag, 2000
3. J B Conway “ Functions of One Complex Variable” Springer , USA, 1978
4. N I Akhiezer “ Elements of the theory of Elliptic Functions”, American mathematical Society, USA, 1990
5. Joel S Chiff “ Normal families “ Springer, USA, 1993,

MA 764 Geometric Function Theory **L T P C**
3 0 0 3

UNIT –I (9 Hrs)
Normal families & applications, Riemann mapping theorem, Conformal mapping of a sequence of domains;

UNIT- II (9 Hrs) Modular function, Hyperbolic metric, Elementary theory of univalent functions, Löwner‟s
theory,

UNIT-III (9 Hrs)
Dirichlet problem, Green‟s function & conformal mapping; Transfinite diameter & capacity; Symmetrization, Extremal length and prime ends.

UNIT- IV (9 Hrs)
Sub classes of univalent functions : Starlike , convex and spiral like functions

UNIT- V (9 Hrs)
Inverses of univalent functions : different methods

Total (45 Hrs)

Reference:

1. P L Duren “ Univalent functions” Springer-verlag (1984)
2. A. W. Goodman “ Univalent Functions Vol: I & II “ , Mariner Publishing Co. Tampa, Florida

MA 765 Differential Geometry **L T P C**
3 0 0 3

UNIT I (9 Hrs)
Curves – Analytical representation – Arc length, tangent – Osculating plane – Curvature – Formula of Frenet.

UNIT II (9 Hrs) Contact – Natural equations – General solution of the natural equations – Helics – Evolutes and Involutes.

UNIT III (9 Hrs) Elementary theory of Surfaces – Analytic representation –First Fundamental form – Normal, Tangent plane – Developable Surfaces.

UNIT IV (9 Hrs) Second Fundamental form – Meusnier Theorem – Euler‟s Theorem – Dupin‟s Indicatrix
– Some surfaces – Geodesics – Some simple problems.

UNIT V (9 Hrs) Equations of Gauss and Weingarten – Some applications of Gauss and the Coddazi equations – The Fundamental Theorem of Surface Thoery.

Total (45 Hrs)

References:

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

2. Willmore, „An Introduction to Differential Geometry‟, Oxford University Press, London, (1972).

3. Thorpe, „Elementary Topics in Differential Geometry‟, Second Edition, Springer Verlag, New York, (1985).

MA 766 Graph Theory **L T P C**
3 0 0 3

UNIT-I (9 Hrs)
Basic definitions. Blocks. Ramsey Numbers. Degree sequences. Connectivity.

UNIT-II (9 Hrs)
Eulerian and Hamiltonian Graphs. Planar graphs and 5-colour theorem. Chromatic numbers. Enumeration.

UNIT-III (9 Hrs) Max-Flow Min-Cut Theorem. Groups and graphs. Matrices and graphs. Matchings and
Hall.s Marriage Theorem.

UNIT-IV (9 Hrs)
Eigen values of graphs, Groups, Schur functions, Polya.s theorem, de Burijn.s theorem, Redfield.s theorem, Matroids,

UNIT-V (9 Hrs)
Transversal theory, Hypergraphs, Planarity, Colourability, Four colour problem.

Total (45Hrs)

Reference:

1. Harary.F " Graph Theory " , 2001, Narosa Publications
2. Narsingh Deo " Graph theory with Application to Engineering and Computer Science "1974, Printice Hall,

MA 767 Fuzzy Mathematics **L T P C**
3 0 0 3

UNIT –I (9 Hrs)

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

UNIT –II (9 Hrs)

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

UNIT -III (9 Hrs) Fuzzy preorder relations -Similitude sub relations in a fuzzy preorder-Antisymmetry - Fuzzy order relations-Ant symmetric relations without loops - Ordinal relations- Ordinal functions in a fuzzy order relation-Dissimilitude relations – Resemblance relations - Various properties of similitude and resemblance- Various properties of fuzzy perfect order relations-Ordinary membership functions

UNIT –IV (9 Hrs) Characteristic function of a fuzzy subset. Fuzzy variables- Polynomial forms-Analysis of a function of fuzzy various variables. Method of Marinos -Logical structure of a function of variables-Composition of intervals-Networks of fuzzy elements-fuzzy propositions and their functional representations-The theory of fuzzy subsets and the theory of probability y- The theory of fuzzy subsets and the theory of functions of structure.

UNIT –V (9 Hrs) Review of the notion of a law of composition-Laws of fuzzy internal composition. - Fuzzy groupoids-Principal properties of fuzzy groupoids -Fuzzy monoids –Fuzzy external composition -Operations on fuzzy numbers

Total (45 Hrs)

References :

1. A.Kaufmann " Introduction to the Theory of Fuzzy Subsets - Volume1". Academic Press New York 1975.
2. Zimmermann "Fuzzy set theory – And its Applications" 4^{tn} edition Kluwer Academic Publishers, London.

MA 768 Operation Research **L T P C**
3 0 0 3

UNIT –I (9 Hrs)

Integer Programming : Pure and mixed integer programming problems and applications – Cutting plane algorithm – The branch and bound algorithm – Gomory‟s cutting plane algorithm – Zero one implicit enumeration. Dynamic Programming: Characteristics of dynamic programming – models in dynamic programming – Capital budgeting problem – reliability problem – shortest route problem - suboptimal problem.

UNIT –II (9 Hrs)

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

UNIT –III (9 Hrs) Queuing Models: Poisson process – pure birth death process – M/M/1, M/M/C, M/Ek/1 queuing models – steady state probabilities – waiting time distribution. Network Models :
Cost Considerations in network models.

UNIT –IV (9 Hrs)

Advanced topics in Linear Programming: Goal programming – Stochastic programming – Sensitivity analysis

UNIT –V (9 Hrs)

Non Linear Programming: Lagrangian multiplier method – Necessary and Sufficient conditions due to Kuhn Tucker – Quadratic Programming by Wolfe‟s Method.

Total (45 Hrs)

References:

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

MA 769 Essential Mathematical Biology **L T P C**
3 0 0 3

UNIT –I (9 Hrs)

Introduction-Linear and Nonlinear First order Discrete Time Models-Differential Equation Models-Evolutionary Aspects-Harvesting and Fisheries-Metapopulations-Delay Effects-Fibonacci‟s Rabbits-Leslie Matrices-Euler-Lotka Equations-The Mckendrick Approach to Age Structure.

UNIT –II (9 Hrs)

The Simple Epidemic and SIS Diseases-SIR Epidemics-SIR Endemics-Eradication and Control – Age - structured Populations – Vector - borne Diseases-Basic Model for Macro parasitic Diseases-Evolutionary Aspects.

UNIT -III (9 Hrs)

Macroscopic Theory of Motion; A Continuum Approach-Directed Motion, or Taxis-Steady State Equations and Transit Times-Biological Invasions: A Model for Muskrat Dispersal-Travelling Wave Solutions of General Reaction-diffusion Equations-Travelling Wave Solutions of Systems of Reaction-diffusion Equations: Spatial Spread of Epidemics.

UNIT –IV (9 Hrs)

Turing Instability-Turing Bifurcations-Activator-inhibitor Systems-Bifurcations with Domain Size-Incorporating Biological Movement-Mechanochemical Models.

UNIT –V (9 Hrs)

Phenomenological Models-Nutrients: the Diffusion-limited Stage-Moving Boundary Problems-Growth Promoters and Inhibitors-Vascularisation-Metastasis-Immune System Response.

Total (45 Hrs)

References :

1. Nicholas F. Britton. ” Essential Mathematical Biology” , Second Indian Reprint, Springer (India) Private Limited. 2007

MA 770 CELLULAR AUTOMATA **L T P C**
3 0 0 3

UNIT-I

(9 Hrs)

Statistical Mechanics of Cellular Automata-Introduction to Cellular automata, Local and Global properties of cellular automata, Extensions

UNIT-II (9 Hrs)

Algebraic properties of Cellular Automata-formalism, Irreversibility, Topology of state Transition diagram, Enumeration of additive cellular automata, on additive cellular automata.

UNIT-III (9 Hrs)

Universality and complexity in cellular Automata-Notion and formalism, Qualitative and Quantitative characterizations of cellular automaton behavior, Classes of cellular automata.

UNIT-IV (9 Hrs)

Two-dimensional Cellular Automata-Evolution from simple seeds, Evolution from disordered initial states, Global properties.

UNIT-V (9 Hrs)

Computation theory of Cellular Automata-Introduction, Construction of finite time sets, Properties of finite time sets, Evolution of finite time sets, invariant sets, limiting behaviors-Physics like models of computation-Reversible cellular automata(RCA)

Total (45 Hrs)

References:

1. Stephen Wolfram "Theory and applications of Cellular Automata" , World Scientific, 1986.

MA 771 Mathematical Elements for Computer Graphics **L T P C**
3 0 0 3

UNIT-I (9 Hrs)
Introduction to computer graphics –Overview of computer graphics-Representing Pictures-Preparing Pictures for Presentation-Presenting Previously Prepared Pictures-Interacting with the Picture-Description of some Graphics Devices-Storage Tube Graphics Devices-Storage Tube Graphics displays

UNIT-II (9 Hrs)
Two Dimensional Transformations-Introduction-Representation of Points-Transformation of Points-Transformation of Straight Lines-Midpoint Transformation-Transformation of Parallel Lines-Transformation of Intersecting Lines-Rotation-Reflection-Scaling-Combined Transformations-Translations and Homogeneous Coordinates

UNIT-III (9 Hrs) Three-Dimensional Transformations-Introduction-Three Dimensional Scaling- Three Dimensional Shearing- Three Dimensional Rotation- Three Dimensional Reflection-Three Dimensional Translation-Rotations about an Axis Parallel to a Coordinate Axis-Rotations about an Arbitrary Axis in Space-Orthographic Projections-Axonometric Projections-Oblique Projections

UNIT-IV (9 Hrs)
Plane Curves-Introduction-Curve Representation-Nonparametric Curves-Parametric Curves- Parametric Representation of a Circle- Parametric Representation of an Ellipse-Parametric Representation of a parabola- Parametric Representation of a Hyperbola Space Curve –Introduction-Representation of Space Curves-Cubic Splines-Normalized Cubic Splines- B-spline Curves

UNIT-V (9 Hrs) Surface Description and Generation-Introduction- Surface of Revolution –Sweep Surfaces-Quadric Surfaces-Bilinear Surface-B-spline Surfaces- B-spline Surfaces Fitting- B-spline Surfaces subdivision.

Total (45 Hrs)

References:

1. David F.Rogers & J.Alan Adams,"Mathematical Elements for Computer Graphics"- Second Edition Tata McGraw–Hill

MA 772 Mathematical Modeling And Simulation **L T P C**
3 0 0 3

UNIT-I INTRODUCTION TO SIMULATION: (9 Hrs)

System & System environment, Components of system, Types of system, Types of models, Steps in simulation. Study, Advantages and Disadvantages of simulation. Simulation Examples: Simulation of Queuing systems: Concepts of discrete event simulation, Time-Advance Mechanism, Component of Organization of a Discrete-Event Simulation Model.

UNIT-II RANDOM NUMBER GENERATION: (9 Hrs)

Properties of random numbers, Generation of pseudo random numbers, techniques for generating random numbers and Tests for random numbers: Inverse transforms technique, Convolution method and Acceptance rejection techniques.

UNIT -III INPUT MODELLING: (9 Hrs)

Collection, Identifying the Distribution of data, Parameter estimation, Goodness-of-fit tests, Selection input model without data, Multivariate and Time series input model.

UNIT-IV VERIFICATION AND VALIDATION OF SIMULATION MODEL: (9 Hrs)

Length of simulation runs, Validations. Types of simulations with respect to output analysis stochastic nature of output data, Measure of performance and their estimation, Output analysis of terminating simulation, Output analysis for steady state simulation.

UNIT -V CASE STUDIES: (9 Hrs)

Simulation of manufacturing systems, Simulation of inventory control systems, Simulation of pert network.

SIMULATION SOFTWARE: GPSS

Total (45 Hrs)

REFERENCE :

1. Jerry Barks et al - Discrete Event System Simulation, Prentice Hall, NJ, 1996.
2. A.M.Law and W.D.Kelton - Simulation Modeling and Analysis, II Edition, McGraw Hill, NY, 1991.
3. Shannon and E.Robert - Systems Simulations -The Art and Science, Prentice Hall, Englewood Cliffs, NJ, 1975.
4. Irwin R.Miller et al - Probability & Statistics for Engineers, PHI Pvt. Ltd, New Delhi, 1992.
5. Barry L.Nelson, - Stochastic Modeling - Analysis & Simulation, McGraw Hill, NY,1995.

MA 773 Inventory Control and Queuing theory **L T P C**
3 0 0 3

UNIT- I Introduction (9 Hrs)

Introduction - Cost involved in Inventory control - Characteristic of inventory system – Deterministic model - Probabilistic model.

UNIT –II Single station (9 Hrs)

Generalization of the classical models- Negligible set up cost-Optimal reserve inventory level between two machines –Newsboy problem - Base stoke system for patient customer.

UNIT –III Model of parallel station (9 Hrs)

Allocation of Aircraft to route - Scheduling problem - Selection of ware house - Application of parallel station - Inventory Allocation and Inventory budget.

UNIT – IV Model of series station (9 Hrs)

Stock location for a one time demand - Pipeline inventory – Application of series of station - Rail road problem.

UNIT –V Queuing model (9 Hrs)

Introduction – Characteristic Queue system - Model of M / M / I – Formula derivation – Model M / M / I / N – Multiple channel - Multiple channel - Multiple channel with limited capacity.

Total (45 Hrs)

References:

1. Hansmann F " Operation research in production and Inventory control" – John Wiley and Sons Inc , NewYork. – (1962)
2. S.D.Sharma " Operation research " Kedar Nath Ram Nath & Co. ,Meerut
3. Arrow, K.J., Karlin, S. and Scarf, N.,– "Studies in the Mathematical theory of Inventory Production" , Stanford Univ. Press, California. (1958)

MA 774 Genetic algorithms **L T P C**
3 0 0 3

UNIT –I (9 Hrs)

Introduction, Motivation and nature- Genetic algorithms mechanics- GA power- reality therapy – Software engineering of Gas, variations on selection

UNIT –II (9 Hrs)

Niching – multi objective selection – economics of modeling – schemata of the GA game – the scheme theorem and applications

UNIT –III (9 Hrs)

The race – BB decision making – BB mixing – control maps- Competent GA design, variations on crossover - Variations on mutation

UNIT- IV (9 Hrs)

Coding and constraints- Real-coded GAs & evolution strategies - ES analysis & advanced operators- Genetic programming-

UNIT –V (9 Hrs)

Applications of GA : optimization and planning - Parade of applications: 3 Exemplars - Recent applications- Efficient Gas - Competent Gas-

Total (45 Hrs)

References:

1. G.Winter, J.Periaux & M.Galan *"Genetic Algorithms in Engineering and Computer Science"* JOHN WILEY & SON Ltd. in 1995.
2. L.Darrell Whitley & Michael D.Vose *Foundatiions of Genetic Algorithms Volume 3*, Morgan Kaufmann Publishers, Inc.
3. Herbert S.Wilf *Algorithms and Complexity*, Prentice-Hall, 1986,

MA 775 Neural networks **L T P C**
3 0 0 3

UNIT – I (9 Hrs)

Introduction to Neural Networks: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

UNIT- II (9 Hrs)

Essentials of Artificial Neural Networks : Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.

UNIT–III (9 Hrs)

Single Layer Feed Forward Neural Networks: Introduction, Perception Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perception Networks, Limitations of the Perception Model.

UNIT- IV (9 Hrs)

Multi layer Feed forward Neural Networks - Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Back propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

UNIT V (9 Hrs)

Associative Memories Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory, Bi-directional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function. - Architecture of Hop field Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis.

Total (45 Hrs)

Reference

1. S. Rajasekharan and G. A. Vijayalakshmi pai, “Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications”, PHI Publication,2004.
2. Simon H aykin, “Neural Networks- A comprehensive foundation”, Pearson Education, 2001.
3.S.N.Sivanandam, S.Sumathi,S. N. Deepa “Introduction to Neural Networks using MATLAB6.0”,TMH,2006.
4. James A Freeman and Davis Skapura, Neural Networks Pearson Education, 2002.

MA776 Advanced Mathematics **L T P C**
3 0 0 3

UNIT I (9 Hrs)
Calculus of Variations: Euler‟s equation and its generalization; Variational problems with moving boundaries; Rayleigh-Ritz method.

UNIT –II (9 Hrs)
Integral Equations: Classification of integral equations, Neumann‟s iterative method for Fredholm‟s equation of 2nd kind;

UNIT-III (9 Hrs)
Volterra type integral equations; Integral equations of first kind. – Applications

UNIT –IV (9 Hrs) Solution of Partial Differential Equations using Laplace and Fourier Transform methods

UNIT-V (9 Hrs)
Special functions : Bessel and Legendre functions.

Total: (45 Hrs)

References:

1. A.S. Gupta “Calculus of Variations” Prentice Hall India .(1997)
2. Sankara Rao “ Partial Differential Equations”2nd Edition Prentice Hall India
3. B.V. Ramana “ Higher Engineering Mathematics” Tata McGraw Hill (2007)

MA 777 Financial Mathematics **L T P C**
3 0 0 3

UNIT-I (9 Hrs)

Cash flow model: Cash flow process, outflows-Cash flow model for a zero coupon bond – Time value of money – Compound interest and discount –Single investment- Present value- Commercial discount- Interest rate or discount rates- Relationship between rate of interest and discount –Nominal and effective rate of interest.

UNIT-II (9 Hrs)

Rate of inflation: Equal and unequal payments- Real and money interest rates –Variation of interest and discount – Differed/not differed period of time- Compound interest functions including annuities.

UNIT-III (9 Hrs)

Equation of value: Payment or receipt, uncertain receipt, exact solution –Repayment of loans: flat rates, annual effective rates, capital outstanding-Cash flow technique: accumulated profit – Receipts and payment from investment-payback period – Money waited rate of return.

UNIT-IV (9 Hrs)

Investment and risk characteristics: fixed interest for government borrowings/other bodies – Shares and other equity types- Derivatives – Calculation of running yield, redemption yield, effect of inflationary growth- Delivery price and arbitrage free pricing- Hedging.

UNIT-V (9 Hrs)

Structure of interest rates: influencing factors- Part and maturity yields- Relationship between discrete /continuous spot rates and forward spot rates- Convexity of cash flow sequence – Stochastic models for investment returns.

References :

1. Mark S. Joshi " The concepts and practice of Mathematical Finance", Cambridge university press, 2nd Edition (2008)
2. Mc Cutcheon and Scott " Introduction to the Mathematics of Finance", - Heinemann Professional publishing, 1989
3. Paul Wilmott, Sam Howison, and Jeff Dewynne " The Mathematics of Financial derivatives" Cambridge university press, 1995
4. S.M. Ross " An Introduction to Mathematical finance" Cambridge University Press,