



## bus of Course Work for Ph. D (Mathematics)

**Total Hours 90 (6 Credits)**

**Max. Marks 100**

### UNIT I

(14hrs)

#### **Difference Equation and its Application**

Difference Calculus, Linear first – order difference equations, Nonlinear difference equations, Higher order linear difference equations, Systems of difference equations, Stability Theory, Applications.

#### **Suggested readings:**

1. V. Lakshmikantham and V. Raghavendra , A text Book of Ordinary Differential Equations, Tata McGraw Hill,1997.
2. A.H. Nayfeh, Introduction to Perturbation methods, John Wiley ,1981.
3. F. Verhulst, Non-linear Differential Equations and Dynamical Systems, Springer, 1990.
4. P.Prasad and R .Ravindran, Partial Differential Equations, Wiley Eastern, 1985.
5. W.E. Williams, Partial Differential Equations, Oxford Univ. Press, 1980.

#### **Computational Techniques using Mathematica and Matlab**

Mathematica basics. 2 D and 3 D Graphs. Basic Calculus. Ordinary Differential Equations. Partial Differential Equations and Boundary Value Problems. Mathematica Programming. Linear and Nonlinear Integral Equations.

Matrix Operations in MATLAB. Solution of Equations. Curve-fitting. Numeral Integration. MATLAB Programming.

### UNIT II

(14hrs)

#### **Operation Research**

Inventory control of style goods and perishable items. Production planning for unreliable production systems. Integrated production, quality and maintenance models. Production planning and inventory control in fuzzy environment.

Supply chain – definition, decision phases, process view. Centralized supply network versus decentralized operation. Coordination. Bullwhip effect. Multi-echelon supply chains. Simple models of supply chain management.

Solving inventory/supply chain management problem using Genetic Algorithms (GAs).

#### **Suggested readings:**

1. F. S. Hiller and G. J. Leiberman, Introduction to Operations Research (6th Edition), McGraw-Hill
2. International Edition, 1995.
3. G. Hadley, Nonlinear and Dynamic Programming, Addison Wesley.
4. H. A. Taha, Operations Research –An Introduction, Macmillan.  
Kanti Swarup, P. K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi.

## Advanced Ring and Module Theory

Jacobson radical, nilpotent elements, nil idea, nil radical, prime radical.

Semi-simple rings and modules, lifting of idempotent elements.

Minimal prime ideal, primary ring, quasi regular and regular elements, regular rings and their properties.

Local rings.

Exact and split sequences.

Essential and small submodules.

Injective and projective modules.

### Suggested readings:

1. D.M. Burton: A First Course in Rings and Ideals, Addison-Wesley, 1970
2. J. Lambek: Lectures on Rings and Modules, Blaisdell Publishing, 1966
3. Vivek Sahai and Vikas Bist: Algebra, Narosa Publ. House, 2003

## UNIT III

(18hrs)

### Topology

Definition, Basic properties including translations in topological groups, neighbourhood system of identity, separation properties, uniform structure on topological groups.

Locally compact groups, Lie groups, Measure and integration in locally compact spaces and then in locally compact groups, Haar measure, Haar integrals.

### Suggested readings:

1. S. Willard, General Topology, Addison Wesley, 1970.
2. S.W. Davis, Topology, Tata McGraw Hill, 2006

### Numerical Methods

Finite Difference Methods for elliptic, parabolic and hyperbolic problems, Stability, consistency and convergence of finite difference schemes.

Finite Element Analysis, integral formulations and variational methods, finite element discretization of continuum, shape functions, element matrices. Finite element Method for boundary value problems of ordinary and partial differential equations.

Introduction to Finite Volume Method and its application to solve boundary value problems.

### Suggested reading:

1. Tveito, R. winthner, Introduction to Partial Differential Equations: A computational Approach, Springer 1998.
2. A. Quarteroni, A. Valli, Numerical Approximation of Partial Equations, Springer, 1997.
3. M.K. Jain, S.R.K. Iyengar, R.K.Jain, Computational Methods for Partial Differential Equations, Wiley Eastern, 1994.
4. Eastern, 1994.
5. J.N. Reddy, An Introduction to the Finite Element Method, Mc Graw Hill Inc.
6. Daryl L. Logan, A First course in the Finite Element Method, Cengage Learnin , 2007.

## UNIT IV

(20hrs)

### Integral Equations

Basic definitions, regular, singular, hypersingular integral equations. Occurrence of integral equations in classical mechanics, ordinary differential equations, partial differential equations. Occurrence in continuum mechanics (elasticity, fluid mechanics).

Singular integral equations, Abel integral equations, solutions, Cauchy singular integral equations, solutions, applications.

Hypersingular integral equations, solution of simple hypersingular integral equations, applications.

Dual integral equations. Solution for trigonometric function kernels, applications.

### Suggested readings:

1. Abdul J. Jerry, Introduction to Integral Equations with applications, Marcel Dekkar Inc. NY.
2. L.G.Chambers, Integral Equations: A short Course, Int. Text Book Company Ltd. 1976,
3. R. P. Kanwal, Linear Integral Equations

## UNIT V

(24hrs)

### Partial Differential Equations With Applications

Numerical solutions of parabolic PDE in one space: two and three levels explicit and implicit difference schemes. Convergence and stability analysis.

Numerical solution of parabolic PDE of second order in two space dimension: implicit methods, alternating direction implicit (ADI) methods. Non linear initial BVP.

Difference schemes for parabolic PDE in spherical and cylindrical coordinate systems in one dimension.

Numerical solution of hyperbolic PDE in one and two space dimension: explicit and implicit schemes. ADI methods. Difference schemes for first order equations.

Numerical solutions of elliptic equations, approximations of Laplace and biharmonic operators. Solutions of Dirichlet, Neuman and mixed type problems.

### Suggested readings:

1. M. K. Jain, S. R. K. Iyenger and R. K. Jain, Computational Methods for Partial Differential Equations, Wiley Eastern, 1994.
2. Eastern, 1994.
3. M. K. Jain, Numerical Solution of Differential Equations, 2<sup>nd</sup> edition, Wiley Eastern.
4. S. S. Sastry, Introductory Methods of Numerical Analysis, , Prentice-Hall of India, 2002.
5. D. V. Griffiths and I. M. Smith, Numerical Methods of Engineers, Oxford University Press, 1993.
6. C. F. General and P. O. Wheatley Applied Numerical Analysis, Addison- Wesley, 1998.