Solapur University, Solapur.

Ph.D. Course Work in Mathematics

(w.e.f. June 2011)

Paper II: Recent Trends In Mathematics.

UNIT 1:   GRAPH THEORY.

Matrix representation of graphs, Incidence matrix and properties, Circuit matrix and its properties, Application to a switching network, Cutset matrix and it's properties, Adjacency matrix and it's properties, Walk's in graphs and diagraphs.

Reference:

1.   Deo Narsingh : Graph Theory
         (Prentice Hall of India Pvt. Ltd. (2000)

UNIT 2:   FUZZY MATHEMATICS

Fuzzy sets Vs Crisp sets- Basic types, concepts, properties, Representations and Extension principle of Fuzzy sets; Operations on Fuzzy sets- Complements, intersections, unions and its combinations and aggregation; Fuzzy Relations- Binary, Equivalence, Compatibility, Ordering and Fuzzy morphisms; Fuzzy Logic- Classical logic, Multivalued logic, Fuzzy propositions, Fuzzy Quantifiers.

Reference:

1.   Klir G.J., Yuan Bo   :   Fuzzy sets and Fuzzy logic
                                       (Prentice Hall of India)
2.   Ross Timothy   :   Fuzzy Logic
                                       (Wiley India)

UNIT 3:   LATTICE THEORY

Posets, Equivalence of two definitions of Lattice, Properties of Lattice, Homomorphisms, Ideals and Dual ideals, Distributive Lattice, Browerian Lattice, Modular Lattice, Stone Lattice and Pseudo-Complemented Lattice.

Reference:

1.   Gratzer: Distributive Lattices-Basic Concepts
                                (Freeman and Co.)

2.   Birkhoff: Lattice Theory
                                Amer.Math.Soc.Collg.Pub.no.25

UNIT 4:   ALGEBRA OF MODULES

Theory of modules-Definitions, Examples, Submodules, Direct sums, R-homomorphisms, Quotient modules, Completely reducible module.

Reference:

1.   Bhattacharya, Jain, Nagpaul: Basic Abstract Algebra
                                                        (Cambridge University Press)

UNIT 5:   ORDINARY DIFFERENTIAL EQUATIONS

Existence of solutions, Uniqueness, The method of differential equations, The nth order equation, Dependence of solutions on initial conditions and parameters, Complex Systems, Extension of the idea of solution, Max and Min of solutions.

Reference:

1.   Coddingtun E.A., Levinson N.: Theory of Ordinary Differential Equation

UNIT 6:   ANALYSIS

Continuity of functions on R^2, Differentiability of $F : R^m \rightarrow R^n$, Properties of Differential, Directional derivatives, Continuously differentiable functions, Inverse function theorem, Implicit function theorem.

Reference:

1.   "Mathematical Analysis" by T.M. Apostol

Paper III: Advanced Topics in Mathematics

Unit 1 :   Number Theory
Fermat's factorization method, the little theorem, Fibonacci numbers and properties, Certain identities involving fibonacci numbers.

Reference:
1.   Burton David M. : Elementary Number Theory

Unit 2:   Tensor Techniques
Summation Convention, Transformations, Covariant, Contra variant and Mixed tensors, Cartesian tensors, Metric tensors, Algebra of tensors, Christoffel symbols, Derivatives of metric tensors, Laws of transformation of Christoffel symbols.

Reference:
1.Paria G. : A Textbook of Matrix and Tensors
                (Scholar's Publications, Indore.)

Unit 3 :   Functional Analysis
Finite Dimensional Spectral Theory, Matrices, Determinants and spectrum of an operator, The spectral Theorem, Fixed Point Theorem and application to analysis.

Reference:
1. Simmons G.F. : Introduction to Topology and modern Analysis
                (Tata Mc Graw-Hill Publications)

Unit 4 :   Algebra of Rings
Noetherian and Artinian modules and rings, Hom($\oplus M_i$, $\oplus M_i$), Wedderburn-Artin Theorem, Uniform modules, Primary modules and Noether-Lasker Theorem, Decomposition Theorem, Uniqueness of the Decomposition.

Reference:
1.   Bhattacharya , Jain , Nagpal : Basic Abstract Algebra
                                (Cambridge University Press)

Unit 5 : Partial Differential Equations
Second order elliptic equations , Elliptic Equations, Weak solutions, Existence of weak solutions, Regularity, Maximum principles, Eigen values and Eigen functions.

Reference:
1.Evans L.C. : Partial Differential Equations
   (Graduate Studies in Mathematics Vol. 17,AMS 1998)

Unit 6 : Algebraic Topology.

The fundamental Groups, Homotopic paths, Contractible and simply connected spaces, The covering Homotopy property for S^1 , The degree of a loop, Equivalence of loops, Isomorphism between the Fundamental Groups and the group Z of Integers.

Reference :
1. Croom Fred H. : Basic concepts of Algebraic Topology
(Springer Verlag publications)

Syllabus of Ph.D.(Mathematics)

Elective paper

Paper IV

Title of the paper :- **Fuzzy relations, Fuzzy logic ,Fuzzy measures & Support Vector Machines**

Unit No. I:- **Fuzzy Relations**:-

Projections& cylindrical Extensions, Binary fuzzy relations on single set, Fuzzy equivalence relation, fuzzy compactibility relations, fuzzy ordering relations, fuzzy morphisms

Unit No.II:- **Compositions of fuzzy relations**

sup-I compositions & inf-wi compositions, fuzzy relation Equation : problem partitioning, solution methods, fuzzy relational equations based on sup –I & inf-wi compositions ,approximate solutions.

Unit No. III:-**Fuzzy logic**:-

Fuzzy propositions, Fuzzy quantifiers, Linguistic Hedges, inference from conditional fuzzy propositions, Qualified & quantified propositions,

Unit No. IV:-**Fuzzy measures**:-

Fuzzy measures, Semicontinuous Fuzzy measures , λ - Fuzzy measures , Quasi-measures, Belief measures, Possibility measures, Plausibility measures, Necessity measures, Properties of finite fuzzy measures

Unit No. V:- **Quadratic Programming**

Kuhn – Tuckers conditions, Wolfe's method, Beale's method, Simplex method for Quadratic programming.

Unit No VI :- **Support Vector Machines**

Knowledge Discovery Environment, Linear decision surfaces and functions, Perceptron learning,

Maximum margin Classifier,Linear and nonlinear Support Vector Machines, The Kernal trick.

References:-

1) G.Klir, Yuan:- ***Fuzzy sets and fuzzy logic :Theory & applications*** (2000)

2) M. Grabish , sugeno & murofushi :- ***fuzzy measures & integrals theory & applications***(1999)

3) H.J.Zimerermann, ***Fuzzy set theory & its applications*** Kluwer (1984)

4) Z. Wang and G. Klir***, Fuzzy Measure Theory,*** Plenum Press(1992)

5) S. D. Sharma, ***Operation Research,***Kedar Nath Ram Nath and Co. (2006)

Syllabus of Ph.D Course work in Mathematics: Paper IV (Elective)

<u>Lattice Theory</u>

1.Two definitions of Lattice and their equivalence. Duality principle. Description of Lattice by means of a diagram.

2.Homomorphisms , Isomorphisms ,Isotone maps. Sublattice .Convex Sublattice , Interval ,Ideal. The Homomorphisms Theorm.

3.Polynomials ,Identities and Inequalities.

4.Free Lattices , Distributive Lattices, Modular Lattices , Semimodular Lattices.

5.Special elements , zero , unit of Lattice , Complemented Lattices .Boolean algebra and Boolean Lattices.

6.Topological Representations .

7.Fuzzy sets and Fuzzy Lattices .

<u>Reference Book:</u>

Gratzer G. : Lattice theory

W.H Freeman and co.ed 1971

Ph.D. (Course Work) Nature of Question Paper Pattern

- Ph.D. कोर्सवर्कसाठी फक्त Long Answer व Short Answer असेच प्रश्न असतील.

- Ph.D. (Course work) प्रश्नपत्रिकेत कोणताही External Option व Objective प्रश्न असणार नाहीत.

- एकूण प्रश्न - ५ x गुण २० = १०० गुण

- प्रश्न क्रमांक १ ते ५

- (A) दिर्घोत्तरी प्रश्न (१० गुण)

  (B) Answer Any two out of three (प्रत्येकी ५ गुण)

    या प्रश्नपत्रिकेच्या स्वरुपामुळे Internal Option हा २५% राहतो.