Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for M. Sc. In Applied Mathematics

(Effective from Academic Session 2018-2019)
THIRD SEMESTER

MAM 301 : Functional Analysis

(40 CLASSES)

Metric Space: Continuity, completeness, compactness, HOLDER and Minkowski inequalities (statement only),Incomplete Metric space. Theorem of cantor and Baire. Completion of Metric Spaces. ε-nets and totally bounded sets, Operators. Banach's Fixed Point theorem and its application. Contractive Operators.

Normed Linear Space: Linear dependence and independence, Banach Space,S pace and subspace of finite dimentions, quotient space, convex sets.

Linear opretors: Elementary properties, inverse operator, linear functional, Hann-Banach theorem, Conjugate Space, Uniform boundedness principal,strong and weak convergence.

Hilbert spaces:Simple properties of inner product spaces, orthogonality and orthonormality, Perseval's identity. Projection and Reisz representation theorem. Adjoint and self adjoint operators,positive, projection, normal and unitary operators.

Spectral Theory: Finite dimentional spectral theory. Existence Theorem. Spectral Theorem. Uniqueness of Spectral resolution.

Reference Books:

1.Introduction to Functional Analysis- A.E.Taylor

2.Functional Analysis - G.Bachman & L.Narici

3.Elements of Functional Analysis – L.A.Lusternik & v.j.Sobolev

4.Functional Analysis - B.V. Lmaye

5.Functional Analysis- W.Rudin

6. Functional Analysis - K.Yoshida

7.Elements of Functional Analysis – B.K.Lahiri

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MAM 302: Discrete Mathematics

(40 CLASSES)

Mathematical Logic: Propositions and logical connectives, logical connectives, logical equivalence, logical quantifiers, Mathematical Induction.

Combinatorics and Algebric systems: Permutations and Combinations, Recurrence relations, generating functions ,divide and conquer relations, binary operation, semigroup, monoid, isomorphism and homomorphism, products and quotients semi group, cosets and Lagranges Theorem, Algebric coding theory ,group codes.

Graph Theory: Graph, Subgraph, Cyclic Graph, Matrix Representation of a Graph, isomorphism of graphs, Fleury's Algorithm, Hamilton graph, Trees, Binary Trees, Tree Traversal, Spanning trees.

Algorithms- BFS, DFS, Prims, Kruskal, Dijkastra

Automata Theory: Deterministic finite Automata(DFA), Nondeterministic finite Automata(NFA),Conversion of NFA to DFA, Equivalence of NFA and DFA ,finite automata with ^ moves. Language and Grammer-Chomsky classification of grammer, pumping Lemma for context-free grammer, push down automata, turing machine.

Lattice Theory: Partially Oedered set, Hasse diagram, maximal and minimal elements of a poset. Lattice, its properties, lattice as algebraic system, direct product of lattices, sublattice, lattice homomorphism.

Reference Books:

1.Discrete Mathematical Structure for Computer Scientists and Engineers- M.K.Das

2. Discrete Mathematical Structure- C.L.Liu

3. Discrete Mathematical Structure- G.S.Rao

4. Discrete Mathematical Structure for Computer Scientists and Mathematician – Mott,Kandel &Baker

5. Discrete Structures – S.B. Singh, Ekta (Khannabooks.com)

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MAM 303: Information Theory and Decision Analysis

(40 CLASSES)

Information Theory: Measure and information: Axioms for a measure of uncertainty. The Shanon entropy and its properties. Joint and conditional entropies. Transformation and its properties.

Noisless Coding: Ingredients of noisless coding problem. Necessary and sufficient condition for the existence of instaneous cods, optimal codes.

Information function: Equation of information, continuous, non-negative bounded and measurable information functions and entropy. Axiomatic characterizations of Shanon entropy due to Tverberg and Leo.General solution of fundamental equation of information.

Decision Analysis: Decision environment, expected monetary value, perfect information, opportunity loss, decision making under uncertainty, conflict resolution, decision tree analysis, decision making under utility curve, Bayesian analysis.

Markovian decision process: Ergodic matrices, regular matrices, imbedded Markov chain method for steady state solution.

Basic concept of fuzzy logic. Comparison between fuzzy set and crisp set. Membership function. define

with example: core, normal, Height, support, Alpha cut etc. Define convex fuzzy set, cardinality with example.

Fuzzy Operation: Union, intersection, difference, complement etc. algebraic sum, product, bounded sum, bounded difference ,

composition of relation: Max- min, Min-max,max-max method, Fuzzification, Defuzzification to crisp set.

Reference Books:

1.An introduction to Information Theory- F.M.Reza
2.Coding and Information Theory- S.Roman
3.Information Theory- R.Ash
4.Operation Research- H.Taha
5.Operation Research- P.K.Gupta & D.S.Hira
6. Operation Research- K.Swarup,P.K.Gupta &ManMohan
7.Fuzzy sets,Decision Making andExpert System- H.J.Z immermann

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MAM 304: Continuum Mechanics

(40 CLASSES)

Continuum hypothesis: Deformation and flow, Lagrangian and Eulerian methods of description.

Elastic solid media: Elastic deformation, Finite strain deformation in Lagrangian and Eulerian methods, Infinitesimal strain tensor, Geometrical interpretation of strain components, Dilatation.

Analysis of strain: Relative displacement, Strain-displacement relations. Cauchy's strain quadric. Principal strain, invariants. Saint-Venant's equations of compatibility.

Analysis of Stress: Body and surface forces. Stress vector and stress tensor. Stress equations of motion and equilibrium. Symmetry of stress tensor. Stress transformation laws. Cauchy's stress quadric. Principal stress. Stress invariants.

Equation of elasticity: Generalized Hooke's law. Homogeneous isotropic media; elastic moduli for isotropic solid. Equations of motion and equilibrium in terms of displacement. Beltrami-Michell compatibility equations. Fundamental boundary value problems in elasticity, uniqueness of solutions. Strain-energy functions and its connection with Hooke's law.

Waves in elastic media: Body waves of dilatation and distortion. Surface waves-Rayleigh and love waves.

Fluid media: Kinemalis of fluids in motion-Lagrangian and Eulerian methods of description, acceleration of a fluid particle, equqtionsof continuity in Euler and Lagrangian for inviscid liquid, Cauchy integrals, integration of Euler's equation of motion, Bernoulli's equation Kelvin's theorem of minimum kinetic energy constancy of circulation Motion in two dimentional sources,sinks and doublets Viscous flow – Navier-stocks equations, plane poiseulle and coquette flow.

Reference Books:

1.Introduction to the Mechanics of a Continuous Medium- L.E.Malvern
2. Continuum Mechanics- F.Irgens
3.Applied Continuum Mechanics- T.J.Chung
4.Mathematical Theory of Elasticity- I.S.Sokolnikhoff
5.Foundation of Solid Mechanics- Y.C.Fung
6.Hydromechanics- Besant and Ramsag
7. Hydromechanics- H.Lamb
8. Engineering Mechanics-D.S. Bedi

MAM E 305: Elective I

MAM E305 A: FINANCIAL MATHEMATICS

(40 CLASSES)

Brownian motion, geometric Brownian motion, interest rates and present value analysis, rate of return, options pricing orbitrage theorem, multi period binomial theorem.

Black-scholes formula, properties of Black-scholes option cost, Delta-Hedging arbitrary strategy.

Call options on dividend paying securities, dividend for share, pricing for American put options, jumps to Brownian motion, volatility parameter. Valuating by expected utility, limitations of arbitrage pricing, portfolio selection problem, value and conditional value at risk, capital assets pricing model, mean varience analysis of risk neutral priced call options.

Deterministic optimization model concave return functions and knap-sack problems. probability optimization model gambling and investment allocation problems.

Exotic options: Barrier, Asian and Lookback options, Monte Carlo simulation, pricing exotic options by simulation.

Autoregressive models and mean reversion.

Reference Books:

1.An elementary Introduction to Mathematical Finance – S.M. Ross

2.An introduction to Mathematics of Financial Derivatives –S.N.Neftchi

3.Mathematics of Financial Markets-R.J.Elliot and P.E. Kopp

4. Elements of Mathematical Analysis – R.Agor

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MAM E305 B: ADVANCED OPTIMIZATION TECHNIQUES

(40 CLASSES)

Max-flow Mini-cut theorem, minimum cost flows.

Inventory control: Single-item deterministic models without shortages and with shortages, models with price breaks, dynamic demand inventory models, single item stochastic models without and with set up cost. Multi-item inventory models with limitations on warehouse capacity, inventory capacity, capital investment.

Linear multi-objective programming (LMOP):Conversion of LMOP to linear programming, Minsum and priority based GOAL programming (GP) approaches to LMOP problems.

Genetic algorithms(GA):Robustness of Gas over traditional search models, binary encodings of candidate solutions, schema theorem and Building Block Hypothesis. Genetic operators, GA parameters, reproduction mechanism for producing offspring, Daewinian principal in evaluating objective function, simple GA schemes, GA approaches to optimization problems.

Reliability theory, Failure rate, extreme value distribution, analysis of stochastically falling equipments including the reliability function, reliability and growth model.

Reference Books:

1.Optimization Theory and Applications-S.S.Rao

2.Engineering Optimization:Theory and Practice-S.S.Rao

3.Optimization Methods in Operations Research-K.V.Mital

4.Goal Programming and Extensions-J.P.Ignizio

5.Operations research-H.A.Taha

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MAM E305 C:PROBABILITY AND MEASURE

(40 Classes)

Lebesgue measure: Introduction, the σ-algebra of Lebesgue measurable sets, Countable Additivity, Continuity and the Borel-Cantelli Lemma, Lebesgue measure on R^n ,nonmeasurable Sets.

Lebesgue Measurable Functions :Sums, Products, and Compositions ,Sequential Pointwise Limits and Simple Approximation , littlewood's Three Principles, Egoroffs Theorem, and Lusin's Theorem.

Lebesgue Integration :The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure, The Lebesgue Integral of a Measurable Nonnegative Function ,the General Lebesgue Integral . Countable Additivity and Continuity of Integration, Uniform Integrability and the Vitali Convergence Theorem. Convergence in Measure, Characterizations of Riemann and Lebesgue Integrability.

L^pspaces:spaces l^1 and L^1,spacesL^p with pϵ (1,∞).The Inequalities of Young, Holder, and Minkowski, Convergence in L^P ,dense subsets of L^p.

General concepts of Probability: Probability spaces and random variables**,** expectation, variance and standard deviation**,** law and characteristic function of a random variable.

Conditional probability and independence: Independence of events,σ-algebras, random variable Independence of real valued variables, Independent sequences with prescribed laws

Convergence of random variables: Convergence in probability, Convergence in law, Sequences of independent events, the law of large numbers, the central limit theorem.

Some applications of Probability theory: Density of Bernstein polynomial, The Monte Carlo method.

Reference Books:

1.An introduction to Measure Theory and Probability -Luigi Ambrosio, Giuseppe Da Prato, Andrea Mennucci
2.Lectures on Measure Theory and Probability -H.R. Pitt
3.Measure theory and probability -Alexander Grigoryan
4.Real Analysis - H. L. Royden