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)

COURSE OBJECTIVE:

1. To impart fundamental knowledge, thinking skills and technical skills for superior mastery in the areas of mathematical science and applications.

2. Enable the students to be well placed in leading business organizations anywhere in the world.

COURSE DURATION:
The course duration is of 24 months spread over four semesters with credit hours as per the WBUT norms. The course has sufficient emphasis on mathematical skills as well along with its science and management parts.

COURSE CURRICULUM PLAN:
The Course Curriculum is based on comparative analysis of existing MSc. Applied mathematics and Pure Mathematics curriculums of other Universities, IITs and NITs. The curriculum has sufficient exposure to hands-on skills and is much more directed towards higher employability. It is also well suited for upward accommodation of science graduates and Mathematics graduates.

Eligibility: Any Mathematics Graduate/ Any Graduate in Science with Mathematics as a core subject and Any Engineering Graduate.

Summary

Semester No	Contact hr/wk	Credit
1	31	24
2	31	21
3	23	22
4	21	22
Total	106	89

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Semester - I

A. THEORY							
SL. NO.	CODE	THEORY	CONTACTS PERIODS/WEEK				CREDITS
			L	T	P	TOTAL	
1	MAM101	Abstract and Linear Algebra	4	1	-	5	4
2	MAM 102	Real Analysis	4	1	-	5	4
3	MAM 103	Differential Equations	4	1		5	4
4	MAM 104	Numerical Methods	4	1		5	4
5	MAM105	Data Structure and Algorithms	4	1		5	4
Total of Theory						25	20
B. PRACTICAL							
6	MAM 191	Numerical Methods Lab	-	-	3	3	2
7	MAM 192	Data Structure and Algorithms Lab Using C	-	-	3	3	2
Total of Practical						6	4
Total of Semester			31				24

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Semester - II

A. THEORY							
SL. NO.	CODE	THEORY	CONTACTS PERIODS/WEEK				CREDITS
			L	T	P	TOTAL	
1	MAM 201	Probability and Statistics	4	1		5	3
2	MAM 202	Classical Mechanics	4	1	-	5	3
3	MAM 203	RDBMS	4	1		5	3
4	MAM 204	Complex Analysis	4	1		5	3
5	MAM 205	Operations Research	4	1		5	3
Total of Theory						25	15
B. PRACTICAL							
6	MAM 291	OR Lab	-	-	3	3	3
7	MAM292	RDBMS Lab	-	-	3	3	3
Total of Practical						6	6
Total of Semester			31				21

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Semester - III

A. THEORY							
SL. NO.	CODE	THEORY	CONTACTS PERIODS/WEEK				CREDITS
			L	T	P	TOTAL	
1	MAM 301	Functional Analysis	4	1		5	4
2	MAM 302	Discrete Mathematics	4	1	-	5	4
3	MAM 303	Information Theory and Decision Analysis	4	1		5	4
4	MAM 304	Continuum Mechanics	4	1		5	4
5	MAM E 305	Elective I	4	1		5	4
Total of Theory						25	20
B. PRACTICAL							
6	MAM 391	Seminar	-	-	3	3	2
Total of Practical						3	2
Total of Semester			28				22

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Semester - IV

A. THEORY							
SL. NO.	CODE	THEORY	CONTACTS PERIODS/WEEK				CREDITS
			L	T	P	TOTAL	
1	MAM 401	Integral Transformation and Integral Equation	4	1		5	4
2	MAM E 402	Elective II (Choose any two from 402-A,402-B,402-C,402-D,402-E)	4+4	1+1	-	5+5	4+4
Total of Theory						15	12
B. PRACTICAL							
6	MAM 491	Project Dissertation	-	-	9	9	6
7	MAM 492	Viva Voce	-	-	-	-	4
Total of Practical						9	10
Total of Semester			24				22

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Elective Set	Course Code	Topic
I (Choose any one)	MAM E305 A	Financial Mathematics
	MAM E305B	Advanced Optimization Techniques
	MAM E305 C	Probability and Measure
II(Choose any two from the set)	MAM E 402 A	Mathematical Biology
	MAM E 402 B	Software Engineering
	MAM E 402 C	Network Security
	MAM E 402 D	Dynamical System
	MAM E 402 E	Cryptography

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FIRST SEMESTER

MAM-101: ABSTRACT AND LINEAR ALGEBRA
(40 CLASSES)

Abstract Algebra:
Group and its elementary properties, direct product, internal and external direct products and their relation. Group actions, conjugacy class equation, Cauchy's theorem, P-groups, Sylow theorems; Simple groups, non simplicity of groups of $(n>1)$, pq, q, (p,q being both prime). Solvable and nilpotent groups, normal and composite series, Jordan-
Holder Theorem. Commutative Subgroups, Necessary and sufficient condition for solvability of group. Insolvability of $(n\geq 5)$. Finite Abelian groups.

Ring Theory. Ideal and homomorphism, quotient ring, Isomorphism,Prime and maximal ideals. Noetherian and Artinan ring with identity.

Linear Algebra:
Matrices over a field. Matrix, characteristic and minimal polynomials, eigen values and eigen vectors. Caylay-Hamilton Theorem.
Linear transformation(L.T), rank and nullity, dual space and basis, representation of L.T by matrices. Change of basis.
Normal form of matrices. Invariant factors and elementary divisors. Unitary similarity, unitary and normal operators on inner product spaces. Triangular, Jordan and rational form of matrices.
Bilinear forms, equivalence, symmetric and skew- symmetric forms. Sylvester law of inertia for quadratic form. Hermitian form.
Modules, modules with basis, rank of a finitely generated module.

Reference Books:

1. Topics in Algebra- I.N.Herstein
2. Fundamentals of Abstract Algebra – Malik,Mordeson & Sen
3. A First Course in Abstract Algebra-J.B.Fraleigh
4. Lectures in Abstract Algebra-N.Jacobson
5. Contemporary Abstract Algebra- J.A.Gallian
6. Linear Algebra-K.Hoffman & R.Kunze
7. Introduction to Linear Algebra-G.Strang
8. Linear Algebra-G.E.Shiby
9. Foundation of Linear Algebra-A.I.Malcev
10. Linear Algebra-J.H.Kwak & S.Hong
11. Linear Algebra and Matrix Theory-E.D.Nering

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MAM-102: REAL ANALYSIS (40 CLASSES)

Elementary set theory, finite, countable and uncountable sets. Real number system as a complete ordered field. Archimedean property, supremum, infimum.

Riemann-Stieltjes integral, properties, integration and differentiation, fundamental theorem of calculus.

Sequence and Series,convergence, limsup,liminf. Bolzano-Weierstrass Theorem. Heine-Borel Theorem.

Sequence and Series of Function,pointwise and uniform convergence, Cauchy Criterion for uniform convergence. Weierstrass's M-Test, Abel's and Dirichlet's Test for uniform convergence, uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation Theorem. Power Series,uniqueness theorem. Abel's and Tauber's Theorem.

Function of Several Variables. Directional derivative,derivative as a linear transformation.Taylor's Theorem,Inverse function and implicit function theorem,Jacobians,extremum problems with constraints.

Monotonefunctins, types of discontinuity,functions of bounded variation,Lebesgue measure and Lebesgue integral.

Reference Books:

1. Mathematical Analysis- T.M.Apostol
2. Mathematical Analysis – R. Agor
3. Real Analysis- R.R.Goldberg
4. Theory of Function of Real Variable (Vol.1)- I.P.Natanson
5. Principle of Mathematical Analysis-G.W.Rudin
6. Analysis I and II-Serge Lang
7. Real Analysis: An Introduction- A.J.White

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MAM-103: DIFFERENTIAL
EQUATION (40 CLASSES)

Ordinary Differential Equation(ODE):
Existence and uniqueness of solution of initial value problem of first order ODE. General Theory of homogeneous and non homogeneous ODE,Wronskian,Abel identity,adjoint and self-adjoint equation. Strum-Liouville equation and boundary value problem. Green function. Solution of Second order ODE, in complex domain, existence of solution near an ordinary point and a regular singular point. Solution of Bessel and Legendre equation. Bessel's functions,generating fnction, for integral index, recurrence relation, representation for the
indices and - , Bessel's integral formula, Bessel's functions of second kind. Legendre polynomials,generating function,reccurence relation, Rodrigue's formula,Schlafli's and Laplace's integral formulae, orthogonal property.

Partial Differential Equation(PDE):
Lagrange's and Charpit's method of solving first order PDE, Cauchy-Kwalewski theorem(Statement only),Cauchy problem for first order PDE, classification of second order PDEs. General solutions of higher order PDEs with constant coefficients. Solution of Laplace,heat and wave equation by separation of variables method(upto two-dimensional cases).

Reference Books:
1. Ordinary Differential Equation- M.Birkhoff and G.C.Rota
2. Ordinary Differential Equation- E.L.Ince
3. Differential Equation- G.F.Simmons
4. Ordinary Differential Equation-Ross
5.Theory of Ordinary Differential Equation- E.E.Coddington & N.Levinson
6.Special Function and Their Application-N.N.Lebedev
7. Special Functions of Mathematical Physics and Chemistry- I.N.Sneddon
8.An Introduction to The Theory of Functions of a Complex Variable- E.T.Copson 9. Elements of Partial Differential Equation- I.N.Sneddon
10. Partial Differential Equation-E.Epstein
11. Introduction to Partial Differential Equation-G.Greenspan
12. Introduction to The Theory of Partial Differential Equation-M.G.Smith

MAM 104: NUMERICAL
Methods (40 CLASSES)

Interpolation: Confluent divided difference,Hermite interpolation, interpolation by iteration- Aitken's and Neville's Schemes. Cubic Spline interpolation,minimizing property and error estimation.

Approximation of function: Least square, weighted least square and mini-max polynomial approximations. Orthogonal polynomials, Gram-Schmidt orthogonalisation process, Chebyshev's polynomials.

Numerical integration: Gaussian quadrature formula and its existence. Bernoulli polynomials and Bernoulli numbers. Euler-Maclaurin sum formula and Gregory –Newton quadrature formula, Romberg integration.

System of linear algebraic equations. Factorization and SOR methods. Eigen value and eigenvector problems-Jacobi and Power methods.

Nonlinear equations: Fixed point iteration, Newton-Raphson, modified Newton- Raphson, Muller and inverse interpolation methods, error estimations and convergence analysis.

Ordinary differential equations: Picard's successive approximation, Euler, Runge- Kutta, Milne's predictor-corrector methods, error estimations and convergence analysis.

Boundary value problems: Shooting method, error estimate and convergence analysis.

REFERENCE BOOKS

1. Introduction to Numerical Analysis - C.E.Froberg
2. Introduction to Numerical Analysis - F.B.Hilderbrand
3. Numerical Analysis –Fished
4. A First Course in Numerical Analysis – A.Ralston & P.Rabinnowits
5. Numerical Analysis- K. Atkinson & W. Cheney
6. Numerical Analysis- K.David & W.Cheney
7. Numerical Methods for Scientific and Engineering Computation-M. F. Jain ,S.R.K. Iyenger &P.K. Jain
8. A Text Book of Numerical Analysis- D.C .Sanyal & K.Das
9. Computer Oriented Numerical Methods – R.S. Salaria

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MAM-105: DATA STRUCTURE AND ALGORITHM

(40 CLASSES)

Introduction to Data Structure and Algorithm. Use of Big O and Small o
Big Omega and small omega notations. Efficiency of algorithms. Analysis of recursive programs.Solving recurrence equation, divide and conquer algorithms.Dynamic programming,Greedy algorithms.
Implementation of Abstract Data Types(ADT),list,stack,queue hashing. Tree Structure,binary trees,AVL trees,Red-Black Trees,priority queues,Tree-Traversal Algorithms,Graphs and algorithms.Prim's and Kruskal's algorithms,Dijkstra's method,backtracking minimum spanning trees,Sorting and searching algorithms.
Introduction to NP problem, polynomial time,abstract problems,encoding; NP completeness and reducibility, circuit satisfiability, NP complete problem; Vertex cover,subset- sum,Hamiltonian-cycle,Travelling-Salesman Problem.

Reference Books:

1. Data Structures Using C – R.S. Salaria
2. Expert Data Structures with C++ - R.B.Patel
3. Data structure using c and c++ - Tanenbaum
4. Fundamentals of Data structure in c++ E.Horwitz,Sahni,D.Mehta
5. Introduction to Algorithms – T.H.Cormen,C.E.Leiserson & R.L.Riveit
4. The Design and Analysis of Computer Algorithms- A.V.Aho, J.E.Hoperoft & J.D.Ullman

MAM 191
Numerical Methods Lab (30 classes)

Solving various problems In C. 2. Implement Numerical problems Using C/MAT LAB 3. Assignments on Interpolation: Newton forward &backward, Lagrange Assignments on Numerical Integration: Trapezoidal Rule, Simson's 1 /3 Rule, Weddle's Rule 5. Assignments on Numerical solution of a system of linear equation: Gauss elimination, Gasuss Jacobi, Matrix Inversion, Gauss Seidel 6. Assignments on Algebraic Equation: Bisection, Secant, Regula-falsi, Newton Raphson 7. Assignments on Ordinary Differential Equation: Taylor Series, Euler's method, RungaKutta.

MAM 192
Data Structure and Algorithms Lab Using C (30 classes)

Programming using C, study of various features of the language, Structured and modular programming, various data structures in applications such as sorting, searching, string and list manipulation.

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SECOND SEMESTER

MAM 201: PROBAILITY AND STATISTICS
(40 CLASSESS)

Probability Theory: Joint, marginal and conditional distributions, moments and conditional moments, correlation and regression, transformation of variables, bivariate normal and Dirichlet distribution.
Multivariate distribution: ,t and F distributions. correlation and regression; Multinomial, uniform distribution on bounded subsets of, multivariate normal and Dirichlet distributions, Cauchy distributions. Order statistics.
Chebyshev's Inequality, Convergence in probability, Bernoulli's theorem, Convergence almost surely,weak law of large numbers, Central and De-Moivre Laplace limit theorems.
Statistics: Sampling distribution: ,t and F distributions.
Estimation: Method of moments,maximum likelihood estimation, unbiasedness, consistency, comparing two estimators, confidence interval estimation for mean, difference of means, variance, proportions, sample size problems.
Test of Hypothesis: Neyman-Pearson Lemma, composite hypothesis, comparison of normal populations, large-sample test,test on multinomial distributions, goodness of fit.
Curve fitting and Correlation: Principle of least squares and curve fitting, correlation and regression, scatter diagram,regression lines,bivariate frequency distribution.
Theory of errors: Gauss Postulate of arithmetic mean, normal law, error function. Principle of least squares,confidence interval.

Reference Books:

1. Elements of Probability and Statistics – A.P.Baisnab and M.Jas
2. Probability and Statistics – M.H.Degroof
3. Elementary Probability Theory – Chung
4. Modern Probability Theory and Application – E.Parzen
5. Mathematics of Statistics Vol I & II – J.F.Kenney & E.S.Keeping
6. Introduction to Statistics – R.G.D.Steel
7. The Practice of Business Statistics – Manish Sharma & Amit Gupta

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MAM-202: CLASSICAL MECHANICS
(40 CLASSES)

Generalised coordinates, degrees of freedom, holonomic and non holonomic systems, scleronomic and rhenomic systems, D'Alemberts's Principle, Lagrange's equation, energy equation for conservative fields, cyclic (ignorable) coordinates, generalized potential. Moving coordinate system with relative translational motion. Rotating coordinate system, Coriolis Force and its effect on freely falling particle.
Euler's equation of motion of a rigid body. Eulerian angle.
Calculus of variations and its application for the shortest distance, minimum surface of revolution, Branchistochrone problem, geodesic.
Hamilton's Principle, Principle of least action, Hamilton's equation of motion.
Cannonical coordinates and canonical transformations. Poincare's theorem.

Lagrrange's and Poisson's Brackets. Legendre transformation. Generating functions. Condition of Cannonicality. Hamilton's equation of motion in Poisson bracket.
Hamilton- Jacobi equation. Hamilton's Principle function and characteristic function.
Small oscillation, general case of coupled oscillation. Eigen vectors and eigen frequencies, orthogonality of eigen vectors. Normal coordinates.

Reference Books:

1. A Treatise of Analytical Dynamics of Particles and rigid Bodies- E.T.Whttaker
2. Dynamics- D.T. Greenwood
3. Dynamics-F.Chorlton
4.Classical Mechanics- H.Goldstein
5. Mechanics: Newtonian,Classical,Relativistic Theory,Problems and Application.
6. Engineering Mechanics: D.S. Bedi

MAM 205: OPERATIONS RESEARCH
(40 CLASSESS)

Revised simplex method and algorithm approaches to linear programming problem, dual simplex method, decomposition principle and its use to linear programming for decentralized planning problems.
Bi-Criterion Transportation models, cost and time minimizing transportation problems, trade off ration technique.
Waiting lines- characteristics of a queuing system, arrival and service patterns, single and multiple channel, queue model with Poisson arrival and exponential service times.
Simulatin Modelling: Monte-Carlo Simulation, using random numbers, applications in waiting lines, maintenance and finance areas.
Replacement Models: Different types of replacement models, replacement of assets deteriorating with time; Markov Analysis-Brand Switching analysis, Prediction of market shares for future periods, equilibrium conditions, Uses of Markov analysis. Dynamic Programming: Basic features, Bellman's principle, multi-stage decision process.

Reference Books:

1. Operation Research: H.A. Taha
2. Operation Research: A.Ravindran, D.T.Philips & J.J.Solberg
3. Operation Research:J.K. Sharma
4. Principle of Operation Research: H.W.Wagner
5. Nonlinear and Dynamic Programming: g.Hadley

MAM 204: COMPLEX ANALYSIS
(40 CLASSES)

Complex Integration: Cauchy-Goursat theorem. Cauchy integral formula. Higher order derivatives. Morera's Theorem.Cauchy inequality and Liouville's Theorem. Fundamental Theorem of Algebra.Taylor's Theorem.Maximum Modulus Principle. Convex
function, Hadamard's Three circle theorem. Schwarz Lemma. Laurent's Series.Isolated singularities.Meomorphic functions,Rouche's Theorem,Inverse function theorem, Open mapping theorem.
Residues: Cauchy Residue Theorem, Evaluation of integrals. Branches of mang-valued functions with special reference to argz, logz, and . Branch Points.

Bilinear Transformations: Properties and classification. Definition and examples of conformal mappings.

Reference Books:

1. Complex Variables and Applications – R.V.Churchiv & J.W.Brown
2. Functions of One Complex Variable –J.B.Conway
3. Theory of Functions of One Complex Variable, vol I & II – A.I.Markushivch.
4. Foundation of Complex Analysis – S.Pommusamy
5. The Theory of Function – E.C.Titchmarsh
6. Complex Analysis – S.Lang

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MAM 203: RDBMS
(40 CLASSESS)

Overview of Database Management; Conceptual,logical and Physical Database Design.
Relational Database: Relation, Optimization,Catalog,Base relvars and views,transitions,the suppliers and parts database.
Relational Model: Constraining, referential integrity constraints,update operators on relations,Structural Query Language (SQL),Data Definition Language Commands, Data Manipulation Language Commands, Transaction Control Commands,SQL Command syntax and usage.Basic query block,Querying Data with multiple conditions,Bassic Relational Algebra operations,The Select Operation,Additional Relational operations.
ER – and EER – To Relational Mapping: ER to relational Mapping Algorithm, Summary of mapping for model constructs and constraints, Mapping EEr Model concepts to relation.
Query, Processing and Optimization: Query Processing, Query Optimization, Database tuning
Object Oriented Database Systems : Characteristics of an Objective Relation Database Management System(ORDBMS),Complex Objects,Inheritance,Function Overloading ruls.
Distributed Database: Distributed Database system and Design,Data Fragmentation,Data Replication,Data Allocation,Query Processing in Distributed Databases.
Recovery: Transactions; Transactions -,System and Media Recovery,Two phase Commit.

Reference Books:

1. Database System Concepts – Silberchatz,Korth & Sudarshan
2. Fundamentals of Database Systems – R.Elmasri & S.Navathe
3. Database Design and rlational theory : Normal Forms and All that Jazz – C.J.Date
4. Database Management Systems – R.P. Mahapatra.

MAM 291
OR Lab using C (30 classes)

Linear Programming (Tranportation , Assignment , Duality , Simplex), Revised

Simplex Method, Simulation Method, Queuing Theory, PERT/CPM

MAM 292
RDBMS (30 classes)

Study of commercial DBMS package such as Oracle. Developing database application with Oracle Creation of a database, writing SQL queries and retrieving data, PL/SQL.

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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

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FOURTH SEMESTER

MAM 401 : INTEGRAL TRANSFORMS AND INTEGRAL EQUATION

(40 Classes)

Integral transformation :Laplase transformation (L.T): Defination and basic properties, Laplase integral lerch's theorem (statement only), L.T of elementary function of derivatives and direc-delta function. Differentiation and integration, convolution of L.T. Inverse L.T.

Fourier transformation(F.T): Definition and basic properties.F.T of some elementary function of derivatives. Inverse F.T. convolution theorem, Perseval's relation. Application of Fourier inversion and convolution theorem. Fourier sine and cosine transformation.

Application of integral transforms of solve two-dimensional Laplase and one dimensional diffusion and wave equation.

Integral Equation :Definition and classification. Linear Integral Equation (I.E) of first and second kind of Fredholm and Voltera type.Relation of boundary value problem of ordinary Differential Equations of integral equations.

Fredholm equation: solution by the method of successive approximation, resolvent karnel . solution in terms of resolvent Karnel , separable karnel, iterative scheme.

Voltera equation : Solution by successive approximation and resolvent karnel.

Hilbert-Schmidt theory : Symmetric kernels, orthogonal system of function, fundamental properties of eigen values and eigen function for symmetric karnels, Hilbert-Schmidt theorem.

Reference Books

1. Integral Transformation – D.V Wider
2. Operation calculus – N.V Mclachar
3. Operational Mathematics- R.V Churchill
4. The use of Integral Transforms- I.N Sneddon
5. Linear Integral Equation- W.V Lovitt
6. Integral Equation- F.G Tricomi
7. Linear Integral Equation- S.G Mikhlin
8. Linear Integral Equation- R.P Kenwa

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MAM E 402: Elective II

MAM E 402 A: MATHEMATICAL BIOLOGY
(40 Classes)

Microbial population model: Microbial growth in chemostat stability of steady states growth of microbial population,product formation due to microbial action,competition for a growth of microbial population,product formation due to microbial action,competition for a growth rate limiting substrate in chemostat.

Models in ecology:single-species population model-Malthus,logistic,Gompertz models,Allee effect,qualitative analysis of model equation,Hervest model,discrete-time models,density independent growth,delay population models.Two species models-Lotka-Volterra,predator-prey,competition and mutualism models.

Elementary dynamics of exploited populations: constant rate harvesting,fishing effort,generalised logistic models depensation,yield-effort curves,critical depensation.

Open-Access Fishery: Gordan's static model,opportunity cost,economic fishing,production function,cobb-Dougles production function,discounting,Schaefer model,effect of discounting.

Multi –species models in fishery management: combined harvesting of two ecologically independent fish species following logistic growth,Bionomic equilibrium,optimal harvest policy,combined harvesting of two competing fish species following logistic growth.

Epidemic models:Deterministic andstochastic models without and with removal,control of epidemic

Genetic models: Genetic matrices ,Hardy-Weinberg law,application of Baye's theorem in genetics,model for inheritance of genetic characteristic,e.g. phenotype ratios,bold groups,inheritance if sex link.

Reference Books:

1. Mathematical Bioeconomics,The optimal Management at renewable Resources,John Wiley & sons,New York- C.W.Clark
2. Bioeconomic Modelling and Fisheries Management- C.W.Clark
3.Mathematical Biology- J.D Murry
4.The Mathematical approach to Biology and Medicine- J.N. Kanpur
5.Element of Mathematical Biology- J.Lotka
6.Models in Ecology- S.T Maynerd

MAM E 402 B:SOFTWARE ENGINEERING

(40 CLASSES)

Introduction, Software product, Software Characteristics, Software Crisis, SDLC models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models.

Software Requirement Specifications (SRS): Feasibility Study, Decision Tables,Decision Tree, SRS Document and characteristics.

Software Design: Basic Concept of Software Design, Modular approach: Coupling and Cohesion,Data Flow Diagrams,Flow Charts.

Software Testing: Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing,system testing, Regression Testing,White Box Testing, Control Flow Graphs, Black Box Testing, Verification and Validation, Static Testing Strategies: Formal Technical Review, Walk Through, Code Inspection.

Software Quality: Software Quality Assurance (SQA), SQA Plans, ISO 9000 standards, SEI-CMM Model.

Software Project Management: . Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Function Point (FP) Based Measures, Constructive Cost Models (COCOMO), Software Risk Analysis and Management.Reverse Engineering. An Overview of CASE Tools.

Reference Books:

1. Software Engineering, Rogers G. Pressman, MH

2. Software Engineering, Nasib Singh Gill, Khanna Publishing House.

3. Fundamentals of Software Engineering, Rajib Mall, PHI.

4. An Integrated Approach to Software Engineering, p. Jalote, Narosa Publication House.

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MAM E 402 C :NETWORK SECURITY

(40 classes)

Need for Security, Types of security Attack, Security Services, Information Security, Methods of Protection, principles of security.

Terminologies used in Cryptography, Substitution Techniques, Transposition Techniques.Basics of cryptography: symmetric and asymmetric key, digital signature, digital certificate, KDC.

Network Concepts : Network Reference Models: OSI and TCP/IP Models, Threats in Networks, Network Security Controls, Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange.

Web Security Requirements, Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Electronic Transaction (SET).

Threats to E-Mail, Requirements and Solutions, Encryption for Secure E-Mail, Secure E-Mail System.

Firewalls – Types, Comparison of Firewall Types, Firewall Configurations. VPN.

Reference Books:

1. Atul Kahate, Cryptography and Network Security, McGraw Hill

2. Cryptography and Network Security; McGraw Hill; Behrouz A Forouzan

3. Stallings, W., Cryptography and Network Security: Principles and Practice, 3rd ed., Prentice Hall PTR.,2003

4. Jain V.K., Cryptography and Network Security; Khanna Publishing House.

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MAM E 402 D:DYNAMICAL SYSTEM

(40 Classes)

Phase space and orbits:definition.Autonomous and non –autonomous system.Critical points and linearization.Periodicsolutions.Integralmanifolds.Critical points of nonlinear equations.
Nonlinear oscillation:Conservativesystem,energyintegra,parameter dependent conservative system.Hamiltonian system.
Periodic solution:Bendixoncriterion.Periodicorbit,limitpoint,limitsets.Poincre-Bendixontheorem,limitcycle,existence of periodic solution for Lienardequation.Periodic solution in R^n.

Theory of stability:Stability of equilibrium solutions,stability of periodic solutions,Flocquet'stheorem.Stability by linearization-poincare-Lypunovtheorem.Orbitalstability.Lyapunovfunctions,stability by direct methods.Hamiltonian systems.
Perturbation theory:Basicmaterials,timescale,Naïveexpansion.Poincare'stheorem.Poincare-Lindsted method for periodic solutions of autonomous second –order equations.

Bifurcation theory :Bifurcation,normalization,Poincare theorem on transformation,centremanifolds.Bifurcation of equilibrium solutions and Hofp bifurcation.

Chaos:Lorentz equation and their characteristics,mapping of R into R as a dynamical system,periodicpoint,fixed point of mapping.

Reference Books:

1.Nonlinear Ordinary Differential euation-D.W. Jordan &smith
2.Nonlinear Differential equation and Dynamical system-F.Verhulst
3.An introduction to Chaostic Dynamical system-R.L.Davaney
4.Nonlinear Systems-P.G.Drazin
5.Intrduction to Dynamical system- D.K.Arrowsmith
6.Nonlinear Dynamics and Chaos-Strogatz

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MAM E 402 E:CRYPTOGRAPHY

(40 Classes)

Probability theory:Bernoulli and binomial random variables,geometricdistribution,Markov and Chebyshev'sinqualities,Chernoff's bound
Complexity theory:P,N,PPpolynomial-timereduction,NP-complete problems,randomizedalgorithms,probabilistic polynomial time,non uniform polynomial time
Basic algorithm number theory:Fester integer multiplication,extended E uclid'salgorithms,quadraticresidues,Legendre and jacobysymbols,Chinese remainder theorem,fast molecular exponentiation,choosing random group element,finding a generator of a cyclic group,finding square roots modulo a prime p.polynomial arithmetic in finite fields,factoring polynomial over finite field,isomorphisms between finite fields,computing order of an element,primitiveroots,fastevaiuation of polynomials at multiple points primality testing,Miller-Rabin test,generating random primes,primalitycertificates,algorithms for factorizing computing discrete algorithms.

Publi key cryptography: Diffe-Hellman key exchange,RSA,EL-gamal,Rabin
Algebricgeometry:affine algebraic sets,parametrizations of affine varieties,ordering of the monomials K[X1,…….]division algorithm in K[X……X].Monomial ideas and Dickson's lemma ,Hilbert basic theorem,Grobner basic properties,Buchberger's algorithm.

Private key cryptography:Private key encryption,perfectly secure encryption and its limitation,security,pseudo-random number generator.
Computer approaches to cryptography:basic ideas of computer security,efficient algorithm and negligible success probability,proof by induction,securitynotation CPA,CCA CCA2.
Hash function:Security property of hash function,birth day attack,MAC, construction of hash function number theoretic Hash function,Merkle-Damgard construction.

Reference Books:

1.Mathematics of public key Cryptography-S.DGalbrith
2.Cryptography-Theory & practice-D.R.Stinson
3.An introduction to Mathematical Cryptography –J.Hoffstein,J.H..SILVERMAN
4.Introduction to Modern Cryptography-J.Katz,Y.Lindell
5. Jain V.K., Cryptography and Network Security; Khanna Publishing House.