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)

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. Real Analysis- R.R.Goldberg
3. Theory of Function of Real Variable (Vol.1)- I.P.Natanson
4. Principle of Mathematical Analysis-G.W.Rudin
5. Analysis I and II-Serge Lang
6. 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

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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

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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 structure using c and c++ - Tanenbaum
2. Fundamentals of Data structure in c++ - E.Horwitz,Sahni,D.Mehta
3. 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.