

SIMPLY EASY LEARNING







MATHEMATICS

Subject Code: MA
Course Structure

Sections/Units	Topics	
Section A	Linear Algebra	
Section B	Complex Analysis	
Section C	Real Analysis	
Section D	Ordinary Differential Equations	
Section E	Algebra	
Section F	Functional Analysis	
Section G	Numerical Analysis	
Section H	Partial Differential Equations	
Section I	Topology	
Section J	Probability and Statistics	
Section K	Linear programming	

Course Syllabus

Section A: Linear Algebra

- > Finite dimensional vector spaces
- > Linear transformations and their matrix representations:
 - Rank
 - Systems of linear equations
 - Eigenvalues and eigenvectors
 - Minimal polynomial
 - Cayley-hamilton theorem
 - Diagonalization
 - Jordan-canonical form
 - Hermitian
 - Skewhermitian
 - Unitary matrices
- > Finite dimensional inner product spaces:
 - Gram-Schmidt orthonormalization process



Self-adjoint operators, definite forms

Section B: Complex Analysis

- Analytic functions, conformal mappings, bilinear transformations
- complex integration:
 - Cauchy's integral theorem and formula
 - Liouville's theorem
 - Maximum modulus principle
- Zeros and singularities
- > Taylor and Laurent's series
- > Residue theorem and applications for evaluating real integrals

Section C: Real Analysis

- Sequences and series of functions:
 - Uniform convergence
 - Power series
 - Fourier series
 - Functions of several variables
 - Maxima
 - Minima
- > Riemann integration:
 - Multiple integrals
 - Line
 - Surface and volume integrals
 - Theorems of green
 - Stokes
 - Gauss
- Metric spaces:
 - Compactness
 - Completeness
 - Weierstrass approximation theorem
- > Lebesque measure:
 - Measurable functions
- Lebesque integral:
 - Fatou's lemma
 - Dominated convergence theorem



Section D: Ordinary Differential Equations

- > First order ordinary differential equations:
 - Existence and uniqueness theorems for initial value problems
 - Systems of linear first order ordinary differential equations
 - Linear ordinary differential equations of higher order with constant coefficients
- Linear second order ordinary differential equations with variable coefficients
- Method of Laplace transforms for solving ordinary differential equations, series solutions (power series, Frobenius method)
- Legendre and Bessel functions and their orthogonal properties

Section E: Algebra

- > Groups, subgroups, normal subgroups, quotient groups and homomorphism theorems
- Automorphisms
- > Cyclic groups and permutation groups
- > Sylow's theorems and their applications
- Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domains, Principle ideal domains, Euclidean domains, polynomial rings and irreducibility criteria
- Fields, finite fields, and field extensions

Section F: Functional Analysis

- Normed linear spaces
- Banach spaces
- > Hahn-Banach extension theorem
- > Open mapping and closed graph theorems
- Principle of uniform boundedness
- Inner-product spaces
- > Hilbert spaces
- Orthonormal bases
- > Riesz representation theorem
- Bounded linear operators

Section G: Numerical Analysis

- Numerical solution of algebraic and transcendental equations:
 - Bisection



- Secant method
- Newton-Raphson method
- Fixed point iteration
- > Interpolation:
 - Error of polynomial interpolation
 - Lagrange, newton interpolations
- > Numerical differentiation
- Numerical integration:
 - Trapezoidal and Simpson Rules
- Numerical solution of systems of linear equations:
 - Direct methods (Gauss Elimination, Lu Decomposition)
- Iterative methods (Jacobi and Gauss-Seidel)
- Numerical solution of ordinary differential equations
- > Initial value problems:
 - · Euler's method
 - Runge-Kutta methods of order 2

Section H: Partial Differential Equations

- Linear and quasilinear first order partial differential equations:
 - Method of characteristics
- > Second order linear equations in two variables and their classification
- Cauchy, Dirichlet and Neumann problems
- > Solutions of Laplace, wave in two dimensional Cartesian coordinates, interior and exterior Dirichlet problems in polar coordinates
- Separation of variables method for solving wave and diffusion equations in one space variable
- > Fourier series and Fourier transform and Laplace transform methods of solutions for the above equations

Section I: Topology

- Basic concepts of topology
- Bases
- Subbases
- Subspace topology
- Order topology
- Product topology
- Connectedness
- Compactness
- Countability
- > Separation axioms



Urysohn's lemma

Section J: Probability and Statistics

- Probability space, conditional probability, Bayes theorem, independence, Random
- Variables, joint and conditional distributions, standard probability distributions and their properties (Discrete uniform, Binomial, Poisson, Geometric, Negative binomial, Normal, Exponential, Gamma, Continuous uniform, Bivariate normal, Multinomial), expectation, conditional expectation, moments
- > Weak and strong law of large numbers, central limit theorem
- > Sampling distributions, UMVU estimators, maximum likelihood estimators
- > Interval estimation
- > Testing of hypotheses, standard parametric tests based on normal, distributions
- > Simple linear regression

Section H: Linear programming

- Linear programming problem and its formulation, convex sets and their properties, graphical method, basic feasible solution, simplex method, Big-M and two phase methods
- > Infeasible and unbounded LPP's, alternate optima
- > Dual problem and duality theorems, dual simplex method and its application in post optimality analysis
- > Balanced and unbalanced transportation problems, Vogel's approximation method for solving transportation problems
- Hungarian method for solving assignment problems

