

**A – COURSE OF MATHEMATICS (GENERAL) MATHEMATICS)****PAPER – A****MARKS 35****COMPLEX VARIABLES, LINEAR ALGEBRA AND INFINITE AND FOURIER SERIES****TO BE COVERED IN ABOUT 90 PERIODS****COMPLEX VARIABLES** (1 question to be attempted out of 2)

Complex numbers, De Moivre's theorem and its applications. Exponential, logarithmic, trigonometric, and hyperbolic functions of a complex variable. Separation of complex value functions into real and imaginary parts of complex expressions.

**LINEAR ALGEBRA** (2 question to be attempted out of 3)**1. Vector Spaces.**

Fields, vector spaces, sub spaces and their examples. Linear dependence and independence. Bases and dimensions of finitely spanned vector spaces. Linear transformations of vector spaces. Kernel space, Image spaces, and the relation between their dimensions.

**2. Matrices.**

Motivation of matrices through a system of linear homogeneous and non-homogeneous equations. Algebra of matrices. Determinants of matrices, their properties and their evaluation. Various kinds of matrices. Matrix of a linear transformation. Elementary row and column operations on matrices. Rank of matrix and rank of linear transformation. Evaluation of rank and inverse of matrices. Solution of homogeneous and non-homogeneous equations.

**INFINITE AND FOURIER SERIES** (2 questions to be attempted out of 3)**1. Infinite Series.**

Sequences, infinite series and their convergence. Comparison, quotient, ratio and integral tests of convergence (without proof). Absolute and conditional convergence.

**2. Fourier Series.**

Fourier series. Fourier Sine and Cosine series.

**PAPER – B**

**MARKS 35**

**DIFFERENTIAL AND INTEGRAL CALCULUS**

**TO BE COVERED IN ABOUT 90 PERIODS**

**DIFFERENTIAL CALCULUS** (3 questions to be attempted out of 5)

**1. Bounds, Limits and Continuity.**

Upper and lower bounds of variables and functions. Left and right limits of function. Continuity of functions and their graphic representations. Inverses of exponential, circular, hyperbolic and logarithmic functions.

**2. Derivatives.**

Definition of a derivative. Relationship between continuity and differentiability. Higher derivatives. Leibnitz's theorem.

**3. Mean Value Theorems, Indeterminate Forms and Expansions.**

Rolle's theorem, Lagrange's mean value and Cauchy's value theorems. Indeterminate forms. L'Hospital's rule. Taylor's and Machalurin's theorems.

**4. Plane Curves.**

Curves and their representation in Cartesian, polar and parametric forms. Tangents and normal. Maxima, Minima and points of Inflection. Convexity and concavity. Asymptotes and curve tracing.

**5. Partial derivatives.**

Functions of more than on variables, Partial derivatives, Euler's theorem. Total differentials and implicit functions. Maxima and Minima of functions of more than one variable with or without constraints.

**INTEGRAL CALCULUS** (2 questions to be attempted out of 3)

Riemann sums, Definite and indefinite integrates Properties of definite integrates. Techniques of Integration and reduction formulas. Evaluation of improper integrals, with special reference to Gamma functions, Simple cases of double and triple integrals. Area, surfaces and volumes of revolution.

**PAPER – C****MARKS 35****GEOMETRY****TO BE COVERED IN ABOUT 90 PERIODS****TWO-DIMENSIONAL ANALYTICAL GEOMETRY** (2 questions to be attempted out of 3)

Translation and rotation of axes. General equation of the second degree and the classification of conic sections. Conic in polar coordinates. Tangents and normals.

**THREE-DIMENSIONAL ANALYTICAL GEOMETRY** (3 questions to be attempted out of 5)

Rectangular coordinate system. Translation and rotation of axes. Direction cosines and ratios and angles between two lines. Standard forms of equations of planes and lines. Intersection of planes and lines. Distance between points, lines and planes. Spherical, polar and cylindrical coordinate systems.

Standard form of the equations of sphere, cylinder, cone, ellipsoid, paraboloid and hyperboloid. Symmetry, intercepts and sections of a surface. Tangent planes and normals.

**PAPER – D****MARKS 45****NUMERICAL METHODS AND DIFFERENTIAL EQUATIONS****TO BE COVERED IN ABOUT 90 PERIODS****NUMERICAL METHODS** (2 questions to be attempted out of 3)**1. Numerical Solution of Non-linear Equations.**

Errors in computation. Numerical solutions of algebraic and transcendental equations, isolation of roots, graphical method, dissection methods, iteration methods, Newton Raphson method, method of false position.

**2. Numerical Solution of Simultaneous Linear Algebraic Equations.**

Choleski's Factorization method, Jacobi iterative method, Gauss Seidel method (3x3 matrices only)

**3. Numerical integration.**

Numerical integration, trapezoidal and Simpson's rules.

**DIFFERENTIAL EQUATIONS** (3 questions to be attempted out of 5)

Formation of differential equations. Families of curves. Orthogonal trajectories. Initial and boundary value problems. Different methods of solving first order Ordinary Differential Equation (ODE). Second and higher order linear differential equations with constant coefficients and their methods of solution. Cauchy-Euler Equation. Applications of first order ODE in problems of decay and growth, population dynamics, logistic equation. Simple partial differential equations and their applications.

**B – COURSE OF MATHEMATICS****PAPER – A****MARKS 35****VECTOR ANALYSIS AND STATICS****TO BE COVERED IN ABOUT 90 PERIODS****VECTOR ANALYSIS** (2 questions to be attempted out of 3)

Three dimensional vectors, coordinate systems and their bases. Scalar and vector triple products. Differentiation and integration of vectors. Scalar and vector point functions, concepts of gradient, divergence and curl operators alongwith their applications.

**STATICS** (3 questions to be attempted out of 5)

Composition and resolution of forces. Particles in equilibrium. Parallel forces, moments couples. General conditions of equilibrium of coplanar forces. Principal of virtual work. Friction, Centre of gravity.

**PAPER – B****MARKS 40****VECTOR ANALYSIS AND STATICS****TO BE COVERED IN ABOUT 90 PERIODS****DYNAMICS OF PARTICLE** (5 questions to be attempted out of 8)

Fundamental laws of Newtonian mechanics. Motion in a straight line. Uniformly accelerated and resisted motion. Velocity and acceleration and their components in Cartesian and polar coordinates, tangential and normal components, radial and transverse. Relative motion. Angular velocity. Conservative forces, projectiles, Central forces and orbits, simple harmonic motion, damped and forced vibrations, elastic strings and springs.

**PAPER – C****MARKS 35****VECTOR ANALYSIS AND STATICS****TO BE COVERED IN ABOUT 90 PERIODS****NUMBER THEORY** (2 questions to be attempted out of 3)

Divisibility. Euclid's Theorem (Division Algorithm Theorem), Common Divisors, Greatest Common Divisors, Least Common Multiple. Prime Numbers, Linear Diophantine Equations. Congruences, Residue Systems, Euler's Theorem. Fermat's Theorem. Solution of congruences.

**GROUP THEORY** (3 questions to be attempted out of 5)

Definition and examples of abelian and non-abelian groups. Congruences. Congruences as equivalence relations. Cyclic groups. Order of a group, order of an element of a group. Subgroups. Cosets, The Lagrange's theorem (Connection between the order of a group and order of its elements) and its applications. Permutations. Cycles, length of cycles. Transpositions. Even and odd permutations. Permutation/Symmetric groups. Alternating groups.

**PAPER – D****MARKS 35****VECTOR ANALYSIS AND STATICS****TO BE COVERED IN ABOUT 90 PERIODS****General Topology** (3 questions to be attempted out of 5)

Definitions and examples of topological and metric spaces, open and closed sets. Neighborhoods, limit points of a set, closure of a set and its properties. Interior, exterior and boundary of a set. Definition and examples of continuous functions and homeomorphisms.

**LINEAR PROGRAMMING** (2 questions to be attempted out of 3)

Linear programming in two dimensional space. The general linear programming problem. Systems of linear inequalities. Solution spaces in linear programming. An introduction to the simplex method.

**RECOMMENDED BOOKS.**

1. Karmat H. Dar, Irfan-ul-Haw and M. Ashraf Jagga, “Mathematical Techniques”. (3<sup>rd</sup> edition, 1998), The Carvan Book House, Lahore.
2. Zia-ul-Haq, “Calculus and Analytic Geometry” (1988), The Carvan Books House, Lahore.
3. M. Afzal Qazi, “A First Course on Vectors”, (Revised Edition), West Pak Publishing company Limited, Lahore.
4. Q.K. Ghori (editor), “Introduction to Mechanics”, (Revised Edition), West Pakistan Publishing Co. Ltd., Lahore.
5. S. Manzur Hussain, “Elementary Theory of Numbers”, (1995), the Carvan Book House, Lahore.
6. Muhammad Amin, “Introduction to General Topology”, (1985), Ilmi Kitab Khana, Lahore.
7. Muhammad Iqbal, “An Introduction of Numerical Analysis”, (1988), Ilmi Kitab Khana, Lahore.