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BSc: Mathematics (General): Split Program
University of the Punjab, Lahore
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Mathematics General-I
Calculus (Differential and Integral Calculus)

Note: Attempt six questions by selecting two questions from Section I, two questions from Section II, one question from Section III and one question from Section IV.

Section I (Attempt 2 questions out of 4)

Preliminaries: Real numbers and the real line; Functions and their graphs; Shifting and scaling graphs; Solution of equations involving absolute values; Inequalities
Limit and Continuity: Limit of a function, left hand and right hand limits, Theorems of limits (without proofs); Continuity, Continuous functions
Derivatives and its Applications: Differentiate functions; Differentiation of polynomial, rational and transcendental functions; Intermediate value theorem, Rolle's theorem (without proofs); Mean value theorems and applications (without proofs); Higher derivatives, Leibniz's theorem (without proofs); L'Hospitals Rule; Application of Taylor's and Maclaurin's theorem with their remainders

- Chapter 01: Real numbers, limits and continuity
- Chapter 02: The Derivative
- Chapter 03: General Theorem, Intermediate Forms → Calculus

Section II (Attempt 2 questions out of 4)

Integration and Definite Integrals: Techniques of evaluating indefinite integrals; Integration by substitutions, Integration by parts; Change of variable in indefinite integrals; Definite integrals, Fundamental theorem of calculus; Reduction formulas for algebraic and trigonometric integrands; Improper integrals, Gamma functions; Numerical integration
Plane Analytic Geometry: Conic section and quadratic equations; Classifying conic section by eccentricity; Translation and rotation of axis; Properties of circle, parabola, ellipse, hyperbola Polar
coordinates, conic sections in polar coordinates; Graphing in polar coordinates; Tangents and normal, pedal equations, parametric representations of curves

- Chapter 04: Techniques of Integration
- Chapter 05: The Definite Integral
- Chapter 06: Plane Curves I → Calculus

Section III (Attempt 1 question out of 2)

Applications of Integration: Asymptotes. Relative extrema, points of inflection and concavity; Singular, poirts, tangents at the origin; Graphing of Cartesian and polar curves;Area under the curve, area between two curves; Arc length aid intrinsic equations; Curvature, radius and centre of curvature; Involute and volute, envelope

- Chapter 07: Plane Curves II → Calculus

Section IV (Attempt 1 question out of 2)

Functions of Several Variables and Multiple Integrals: Limit and continuity of a function of two variables; The partial derivative, Computing partial derivatives algebraically; The second-order partial derivative; Tangent planes and normal lines; Maxima and minima of a function of two variables; Double integral in rectangular and polar form; Triple integral in rectangular, Cylindrical and spherical coordinates; Substitution in multiple integrals

- Chapter 09: Functions of Several Variables
- Chapter 10: Multiple Integrals → Calculus

Calculus = *Calculus with Analytic Geometry* Published by *Ilmi Kitab Khana, Lahore.*
Notes/Solutions are available on www.mathcity.org

Mathematics General-II
Mathematical Methods: (Geometry, Infinite Series, Complex Numbers, Linear Algebra, Differential Equations)

Note: Attempt six questions by selecting two questions from Section I, one question from Section II, one question from Section III and two questions from Section IV.

Section I (Attempt 2 questions out of 4)

Complex Numbers: Complex Numbers and their properties; Polar form, argand diagram, separating into real and imaginary parts; De Moivre's theorem and its applications; Elementary functions: circular, logarithmic, hyperbolic, exponential functions; Series solution by using complex numbers
Sequence and Series;
Sequences, Infinite series: Convergence of sequence and series; The integral test, Comparison tests, Ratio test, Root test; Alternative series, Absolute and conditional convergence; Power series, Interval and radius of convergence

- Chapter 01: Complex Numbers
- Chapter 08: Infinite Series → Method

Section II (Attempt 2 questions out of 4)

Vectors: Introduction to vector algebra; Scalar and vector product; Scalar triple product and vector triple product; Applications to geometry; Vector equation of a line and plane; Partial derivatives of vector point functions; Scalar and vector fields; The gradient, divergence and curl
Analytic Geometry of Three Dimensions: Rectangular coordinates system in a space; Cylindrical and spherical coordinate system; Direction ratios and direction cosines of a line; Equation of straight lines and planes in three dimensions; Shortest distance between skew lines; Equation of sphere, cylinder, cone, ellipsoids, paraboloids, hyperboloids; Quadric and ruled surfaces; Spherical trigonometry, Direction of Qibla

- Vector Analysis → *Elementary Vector Analysis*
- Chapter 08: Analytic Geometry of Three Dimensions → Calculus

Section III (Attempt 1 question out of 2)

Matrices, Determinants, System of Linear Equations, and Vector Spaces: Algebra of Matrices, types of matrices; Determinant of square matrix, inverses of matrices; Rank of a matrix; Introduction to systems of linear equations; Cramer's rule, Gaussian elimination and Gauss Jordan method; Solution of homogenous and non-homogenous linear equations; Vector spaces and subspaces; Linear combination Linear independence, Bases and dimension

- Chapter 03: Matrices
- Chapter 04: System of Linear Equations
- Chapter 05: Determinants
- Chapter 06: Vector Spaces → Method

Section IV (Attempt 1 question out of 2)

First Order Differential Equations: Formation of differential equation; Separable equations, Homogeneous and non-homogeneous equations; Linear and nonlinear equations; Exact and non-exact equations and integrating factors; Orthogonal trajectory, Bernoulli, Ricatti, Clairaut's equations
Higher Order Linear Differential Equations: Fundamental solutions of linear homogenous equations; Operator method, Method of undetermined coefficients; Cauchy Euler's equation; Variation of parameters

- Chapter 09: First Order Differential Equations
- Chapter 10: Higher Order Linear Differential Equations → Method

Calculus = *Calculus with Analytic Geometry* Published by *Ilmi Kitab Khana, Lahore.*
Method = *Mathematical Method* Published by *Ilmi Kitab Khana, Lahore.*
Vectors = *Elementary Vector Analysis* published by *The Caravan Book House, Lahore.*