Department of Computer Science

University of Delhi MCA Syllabus

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The syllabus for the MCA Entrance Test would be as follows:

Mathematics: Calculus

Limit and continuity of a function: (ε-δ and sequential approach). Properties of continuous functions including intermediate value theorem, Differentiability, Rolle's theorem, Lagrange's mean value theorem, Cauchy mean value theorem with geometrical interpretations. Uniform continuity. Definitions and techniques for finding asymptotes singular points, Tracing of standard curves. Integration of irrational functions. Reduction formulae. Rectification. Quadrature. Volumes Sequences to be introduced through the examples arising in Science beginning with finite sequences, followed by concepts of recursion and difference equations. For instance, the sequence arising from Tower of Hanoi game, the Fibonacci sequence arising from branching habit of trees and breeding habit of rabbits. Convergence of a sequence and algebra of convergent sequences. Illustration of proof of convergence of some simple sequences such as $(-1)^n/n$, I/n^2, $(1+1/n)^n$, sin n/n, x^n with $0 < x < 1$. Graphs of simple concrete functions such as polynomial, trigonometric, inverse trigonometric, exponential, logarithmic and hyperbolic functions arising in problems or chemical reaction, simple pendulum, radioactive decay, temperature cooling/heating problem and biological rhythms. Successive differentiation. Leibnitz theorem. Recursion formulae for higher derivative. Functions of two variables. Graphs and Level Curves of functions of two variables. Partial differentiation upto second order. Computation of Taylor's Maclaurin's series of functions such as e^x , log(1 + x), sin (2x), cos x. Their use in polynomial approximation and error estimation. Formation and solution of Differential equations arising in population growth, radioactive decay, administration of medicine and cell division.4 Calculus.

Geometry and Vector Calculus:

Techniques for sketching parabola, ellipse and hyperbola. Reflection properties of parabola, ellipse and hyperbola. Classification of quadratic equations representing lines, parabola, ellipse and hyperbola. Differentiation of vector valued functions, gradient, ivergence, curl and their geometrical interpretation. Spheres, Cylindrical surfaces. Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

ALGEBRA

Complex Numbers: Geometrical representation of addition, subtraction, multiplication and division of complex numbers. Lines half planes, circles, discs in terms of complex variables. Statement of the Fundamental Theorem of Algebra and its consequences, De Moivre's theorem for rational indices and its simple applications.

Matrices: R, R^2, R^3 as vector spaces over R. Standard basis for each of them. Concept of Linear Independence and examples of different bases. Subspaces of R^2, R^3 Translation, Dilation, Rotation, Reflection in a point, line and plane. Matrix form of basic geometric transformations. Interpretation of eigenvalues and eigenvectors for such transformations and eigenspaces as invariant subspaces. Matrices in diagonal form. Reduction to diagonal form upto matrices of order 3. Computation of matrix inverses using elementary row operations. Rank of matrix. Solutions of a system of linear equations

using matrices. Illustrative examples of above concepts from Geometry, Physics, Chemistry, Combinatorics and Statistics.

Groups: Definition and examples of groups, examples of abelian and nonabelian groups: the group Z_n of integers under addition modulo n and the group U (n) of units under multiplication modulo n. Cyclic groups from number systems, complex roots of unity, circle group, the general linear group GL (n,R), groups of symmetries of (i) an isosceles triangle, (ii) an equilateral triangle, (iii) a rectangle, and (iv) a square, the permutation group Sym (n), Group of quaternions, Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element, Normal subgroups: their definition, examples, and characterizations, Quotient groups.

Rings: Definition an examples of rings, examples of commutative and noncommutative rings, rings from number systems, Z_n the ring of integers modulo n, ring of real quaternions, rings of matrices, polynomial rings, and rings of continuous functions. Subrings and ideals, Integral domains and fields, examples of fields: Zp, Q, R, and C. Field of rational functions.

Vector spaces: Definition and examples of vector spaces. Subspaces and its properties Linear independence, basis, invariance of basis size, dimension of a vector space. Linear Transformations on real and complex vector spaces: definition, examples, kernel, range, rank, nullity, isomorphism theorems.

Real Analysis

Real Sequences: Finite and infinite sets, examples of countable and uncountable sets. Real line, bounded sets, suprema and infima, statement of order completeness property of R, Archimedean property of R, intervals. Concept of cluster points and statement of Bolzano Weierstrass' theorem. Cauchy convergence criterion for sequences. Cauchy's theorem on limits, order preservation and squeeze theorem, monotone sequences and their convergence.

Infinite Series: Infinite series. Cauchy convergence criterion for series, positive term series, geometric series, comparison test, convergence of p-series, Root test, Ratio test, alternating series, Leibnitz's test. Definition and examples of absolute and conditional convergence. Sequences and series of functions, Pointwise and uniform convergence. M-test, change or order of limits. Power Series: radius of convergence, Definition in terms of Power series and their properties of exp (x), sin (x), cos (x).

Riemann Integration: Riemann integral, integrability of continuous and monotonic Functions

Computer Science:

Data representation, Boolean circuits and their simplification, C-programming: Data types, constants and variables, operators and expressions, control structures, use of functions, scope, arrays.

Logical ability & English Comprehension:

Problem-solving using basic concepts of arithmetic, algebra, geometry and data analysis. Reading comprehension and correct usage of English language.

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