

DEPARTMENT OF COMPUTER SCIENCE

EPABX: 26981717-3452

FACULTY OF NATURAL SCIENCES, JAMIA MILLIA ISLAMIA, NEW DELHI-110025

ENTRANCE TEST-2010

1. MCA & PGDCA (85 Marks / Multiple-Choice- Questions)

FORMAT

Mathematics (10+2 Level)*	: 40 Marks	40 Questions
General English, Computer Awareness & Reasoning	: 45 Marks	15 Questions Each

*SYLLABUS

UNIT-I: SETS AND FUNCTIONS

Sets: Sets and their representations. Empty set. Finite & Infinite sets. Equal sets. Subsets. Subsets of the set of real numbers especially intervals (with notations). Power set. Universal set. Venn diagrams. Union and Intersection of sets. Difference of sets. Complement of a set.

Relations & Functions: Ordered pairs, Cartesian product of sets. Cartesian product of two finite sets. Cartesian product of the reals with itself (upto $R \times R \times R$). Definition of relation, pictorial diagrams, domain, codomain and range of a relation. Function as a special kind of relation from one set to another. Pictorial representation of a function, domain, co-domain & range of a function. Real valued function of the real variable, domain and range of these functions, constant, identity, polynomial, rational, modulus, signum and greatest integer functions with their graphs. Sum, difference, product and quotients of functions.

Trigonometric Functions: Positive and negative angles. Measuring angles in radians & in degrees and conversion from one measure to another. Definition of trigonometric functions with the help of unit circle. Truth of the identity $\sin^2x + \cos^2x = 1$, for all x . Signs of trigonometric functions and sketch of their graphs. Expressing $\sin(x+y)$ and $\cos(x+y)$ in terms of $\sin x$, $\sin y$, $\cos x$ & $\cos y$. Deducing the identities. Identities related to $\sin 2x$, $\cos 2x$, $\tan 2x$, $\sin 3x$, $\cos 3x$ and $\tan 3x$. General solution of trigonometric equations.

UNIT-II: ALGEBRA-I

Principle of Mathematical Induction: Processes of the proof by induction, motivating the application of the method by looking at natural numbers as the least inductive subset of real numbers. The principle of mathematical induction and simple applications.

Complex Numbers and Quadratic Equations: Need for complex numbers, especially, Quadratic equation, Brief description of algebraic properties of complex numbers. Argand plane and polar representation of complex numbers. Statement of Fundamental Theorem of Algebra, solution in the complex number system.

Linear Inequalities: Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical solution of linear inequalities in two variables. Solution of system of linear inequalities in two variables- graphically.

Permutations & Combinations: Fundamental principle of counting, Factorial, Permutations and combinations, derivation of formulae and their connections, simple applications.

Binomial Theorem: History, statement and proof of the binomial theorem for positive integral indices. Pascal's triangle, General and middle term in binomial expansion, simple applications.

Sequence and Series: Sequence and Series. Arithmetic progression (A. P.). arithmetic mean (A.M.) Geometric progression (G.P.), general term of a G.P., sum of n terms of a G.P., geometric mean (G.M.), relation between A.M. and G.M. Sum to n terms of the special series $\sum n$, $\sum n^2$ and $\sum n^3$.

UNIT-III: COORDINATE GEOMETRY

Straight Lines: Brief recall of 2D from earlier classes. Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, twopoint form, intercepts form and normal form. General equation of a line. Distance of a point from a line.

Conic Sections: Sections of a cone: circle, ellipse, parabola, hyperbola, a point, a straight line and pair of intersecting lines as a degenerated case of a conic section. Standard equations and simple properties of parabola, ellipse and hyperbola. Standard equation of a circle.

Introduction to Three -dimensional Geometry: Coordinate axes and coordinate planes in three dimensions. Coordinates of a point. Distance between two points and section formula.

UNIT-IV: CALCULUS-I

Limits and Derivatives: Derivative introduced as rate of change both as that of distance function and geometrically, intuitive idea of limit. Definition of derivative, relate it to slope of tangent of the curve, derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric functions.

UNIT-V: MATHEMATICAL REASONING

Mathematical Reasoning: Mathematically acceptable statements. Connecting words/ phrases - consolidating the understanding of necessary and sufficient, "implies", "and/or", "implied by", "and", "or", "there exists" and their use through variety of examples related to real life and Mathematics. Validating the statements involving the connecting words difference between contradiction, converse and contrapositive.

UNIT-VI: STATISTICS

Statistics: Measure of dispersion; mean deviation, variance and standard deviation of ungrouped/grouped data.

Analysis of frequency distributions with equal means but different variances.

Probability: Random experiments: outcomes, sample spaces (set representation). Events: occurrence of events, 'not', 'and' and 'or' events, exhaustive events, mutually exclusive events Axiomatic (set theoretic) probability, connections with the theories of earlier classes. Probability of an event, probability of 'not', 'and' & 'or' events.

UNIT-VI I: RELATIONS AND FUNCTIONS

Relations and Functions: Types of relations: reflexive, symmetric, transitive and equivalence relations. One to one and onto functions, composite functions, inverse of a function. Binary operations.

Inverse Trigonometric Functions:

Definition, range, domain, principal value branches. Graphs of inverse trigonometric functions. Elementary properties of inverse trigonometric functions.

UNIT-VIII: ALGEBRA-II

Matrices: Concept, notation, order, equality, types of matrices, zero matrix, transpose of a matrix, symmetric and skew symmetric matrices. Addition, multiplication and scalar multiplication of matrices, simple properties of addition, multiplication and scalar multiplication. Non-commutativity of multiplication of matrices and existence of non-zero matrices whose product is the zero matrix (restrict to square matrices of order 2). Concept of elementary row and column operations. Invertible matrices and proof of the uniqueness of inverse, if it exists; (Here all matrices will have real entries).

Determinants: Determinant of a square matrix (up to 3×3 matrices), properties of determinants, minors, cofactors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix. Consistency, inconsistency and number of solutions of system of linear equations by examples, solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix.

UNIT-IX: CALCULUS-II

Continuity and Differentiability: Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit function. Concept of exponential and logarithmic functions and their derivative. Logarithmic differentiation. Derivative of functions expressed in parametric forms. Second order derivatives. Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretations.

Applications of Derivatives: Applications of derivatives: rate of change, increasing/decreasing functions, tangents & normals, approximation, maxima and minima (first derivative test motivated geometrically and second derivative test given as a provable tool). Simple problems (that illustrate basic principles and understanding of the subject as well as real-life situations).

Integrals: Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts, only simple integrals of the type to be evaluated. Definite integrals as a limit of a sum, Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals.

Applications of the Integrals: Applications in finding the area under simple curves, especially lines, areas of circles/ parabolas/ellipses (in standard form only), area between the two above said curves (the region should be clearly identifiable).

Differential Equations: Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given. Solution of differential equations by method of separation of variables, homogeneous differential equations of first order and first degree. Solutions of linear differential.

UNIT-X: VECTORS AND THREE-DIMENSIONAL GEOMETRY

Vectors: Vectors and scalars, magnitude and direction of a vector. Direction cosines/ratios of vectors. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Scalar (dot) product of vectors, projection of a vector on a line. Vector (cross) product of vectors.

Three-dimensional Geometry: Direction cosines/ratios of a line joining two points. Cartesian and vector equation of a line, coplanar and skew lines, shortest distance between two lines. Cartesian and vector equation of a plane. Angle between (i) two lines, (ii) two planes. (iii) a line and a plane. Distance of a point from a plane.

UNIT-XI: LINEAR PROGRAMMING

Linear Programming: Introduction, definition of related terminology such as constraints, objective function, optimization, different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, graphical method of solution for problems in two variables, feasible and infeasible regions, feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints).

UNIT-XII: PROBABILITY

Probability: Multiplication theorem on probability. Conditional probability, independent events, total probability, Baye's theorem, Random variable and its probability distribution, mean and variance of haphazard variable. Repeated independent (Bernoulli) trials and Binomial distribution.

2. M.Sc.(Bioinformatics):(85 Marks / Multiple-Choice- Questions)

FORMAT		
Mathematics (10th Level)*	(40 Marks)	40 Questions
Computer Awareness, General English & Reasoning	(30 Marks)	10 Questions Each
Molecular Biology**	(15 Marks)	15 Questions

SYLLABUS*UNIT I: NUMBER SYSTEMS-1**

REAL NUMBERS: Representation of natural numbers, integers, rational numbers on the number line. Representation of terminating / non-terminating recurring decimals, on the number line through successive magnification. Rational numbers as recurring/terminating decimals. Examples of nonrecurring/ non terminating decimals such as $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$ etc. Existence of non-rational numbers (irrational numbers) such as $\sqrt{2}$, $\sqrt{3}$ and their representation on the number line. Explaining that every real number is represented by a unique point on the number line and conversely, every point on the number line represents a unique real number. Existence of $\sqrt[n]{x}$ for a given positive real number x (visual proof to be emphasized). Definition of n th root of a real number. Recall of laws of exponents with integral powers. Rational exponents with positive real bases. Rationalization of real numbers.

UNIT II: ALGEBRA-1

POLYNOMIALS: Definition of a polynomial in one variable, its coefficients, with examples and counter examples, its terms, zero polynomial. Degree of a polynomial. Constant, linear, quadratic, cubic polynomials; monomials, binomials, trinomials. Factors and multiples. Zeros/roots of a polynomial/ equation. Statement of the Remainder Theorem with examples and analogy to integers. Statement and proof of the Factor Theorem. Factorization of $ax^2 + bx + c$, $a \neq 0$ where a , b , c are real numbers, and of cubic polynomials using the Factor Theorem. Recall of algebraic expressions and identities. Other identities and their use in factorization of polynomials. Simple expressions reducible to these polynomials.

LINEAR EQUATIONS IN TWO VARIABLES: Recall of linear equations in one variable. Introduction to the equation in two variables. Prove that a linear equation in two variables has infinitely many solutions and justify their being written as ordered pairs of real numbers, plotting them and showing that they seem to lie on a line. Examples, problems from real life, including problems on Ratio and Proportion and with algebraic and graphical solutions being done simultaneously.

UNIT III: COORDINATE GEOMETRY-1

COORDINATE GEOMETRY: The Cartesian plane, coordinates of a point, names and terms associated with the coordinate plane, notations, plotting points in the plane, graph of linear equations as examples; focus on linear equations of the type $ax + by + c = 0$ by writing it as $y = mx + c$ and linking with the chapter on linear equations in two variables.

UNIT IV: GEOMETRY-1

INTRODUCTION TO EUCLID'S GEOMETRY: History - Euclid and geometry in India. Euclid's method of formalizing observed phenomenon into rigorous mathematics with definitions, common/obvious notions, axioms/postulates and theorems. The five postulates of Euclid. Equivalent versions of the fifth postulate. Showing the relationship between axiom and theorem. Two distinct points and one point in common.

LINES AND ANGLES: Sum of the two adjacent angles, Intersection and vertically opposite angles, Results on corresponding angles, alternate angles, interior angles when a transversal intersects two parallel lines. Lines, which are parallel to a given line, are parallel. The sum of the angles. Exterior, interiors and opposite angles.

TRIANGLES: Congruence of Triangles, SAS Congruence, ASA Congruence, SSS Congruence; Two right triangles congruence, Triangle inequalities and relation between 'angle and facing side' inequalities in triangles.

QUADRILATERALS: Parallelogram into two congruent triangles, Parallelogram with opposite equal sides and opposite angles and conversely. A quadrilateral, parallelogram and a pair of its opposite is parallel/equal sides.

AREA: Review concept of area, recall area of a rectangle. Parallelograms on the same base and between the same parallels have the same area. Triangles on the same base and between the same parallels are equal in area and its converse.

CIRCLES: Circle related concepts, radius, circumference, diameter, chord, arc, subtended angle. Equal chords and equal angles at the center and its converse. The perpendicular, chord and bisector the chord and converse, one circle passing through three given non-collinear points, Equal chords of a circle. The angle subtended by an arc, Angles and a line segment joining two points subtends equal angle at two other points lying on the same side of the line containing the segment, the four points lie on a circle. The sum of the either pair of the opposite angles.

CONSTRUCTIONS: Construction of bisectors of line segments & angles, 60° , 90° , 45° angles etc., equilateral triangles. Construction of a triangle given its base, sum/difference of the other two sides and one base angle. Construction of a triangle of given perimeter and base angles.

UNIT V: MENSURATION-1

AREAS AND VOLUMES: Area of a triangle using Hero's formula (without proof) and its application in finding the area of a quadrilateral. Surface areas and volumes of cubes, cuboids, spheres (including hemispheres) and right circular cylinders/ cones.

UNIT VI: STATISTICS AND PROBABILITY

STATISTICS: Collection of data, presentation of data – tabular form, ungrouped/ grouped, bar graphs, histograms (with varying base lengths), frequency polygons, qualitative analysis of data to choose the correct form of

presentation for the collected data. Mean, median, mode of ungrouped data. Mean, median and mode of grouped data (bimodal situation to be avoided). Cumulative frequency graph.

PROBABILITY: History, Repeated experiments and observed frequency approach to probability. Classical definition of probability. Simple problems on single events, not using set notation.

UNIT VII: NUMBER SYSTEMS-2

REAL NUMBERS: Euclid's division lemma, Fundamental theorem of arithmetic, Proofs of results - irrationality of $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$, decimal expansions of rational numbers in terms of terminating/non-terminating recurring decimals.

UNIT VIII: ALGEBRA-2

POLYNOMIALS: Zeros of a polynomial. Relationship between zeros and coefficients of a polynomial with particular reference to quadratic polynomials. Statement and simple problems on division algorithm for polynomials with real coefficients.

PAIR OF LINEAR EQUATIONS IN TWO VARIABLES: Pair of linear equations in two variables. Geometric representation of different possibilities of solutions/ inconsistency. Algebraic conditions for number of solutions. Solution of pair of linear equations in two variables algebraically - by substitution, by elimination and by cross multiplication.

QUADRATIC EQUATIONS: Standard form of a quadratic equation $ax^2 + bx + c = 0$, ($a \neq 0$). Solution of the quadratic equations (only real roots) by factorization and by completing the square, i.e. by using quadratic formula. Relationship between discriminant and nature of roots. Problems related to day to day activities to be incorporated.

ARITHMETIC PROGRESSIONS: Motivation for studying AP. Derivation of standard results of finding the n^{th} term and sum of first n terms.

UNIT IX: TRIGONOMETRY

INTRODUCTION TO TRIGONOMETRY: Trigonometric ratios of an acute angle of a right-angled triangle. Proof of their existence (well defined); motivate the ratios, whichever are defined at 0° & 90° . Values (with proofs) of the trigonometric ratios of 30° , 45° & 60° . Relationships between the ratios.

TRIGONOMETRIC IDENTITIES: Proof and applications of the identity $\sin^2 A + \cos^2 A = 1$. Trigonometric ratios of complementary angles.

HEIGHTS AND DISTANCES: Simple and believable problems on heights and distances. Problems should not involve more than two right triangles. Angles of elevation/depression should be only 30° , 45° , 60° .

UNIT IV: COORDINATE GEOMETRY-2

LINES (In two-dimensions): Review the concepts of coordinate geometry done earlier including graphs of linear equations. Awareness of geometrical representation of quadratic polynomials. Distance between two points and section formula (internal). Area of a triangle.

UNIT X: GEOMETRY-2

TRIANGLES: Definitions, examples, counter examples of similar triangles. line is drawn parallel to one side of a, two triangles, the corresponding angles and their corresponding sides. corresponding sides of two triangles, their corresponding angles and the two triangles. Similarity of Triangles – different cases.

CIRCLES: Tangents to a circle motivated by chords drawn from points coming closer and closer to the point. (Prove) The tangent at any point of a circle is perpendicular to the radius through the point of contact. (Prove) The lengths of tangents drawn from an external point to circle are equal.

CONSTRUCTIONS: Division of a line segment in a given ratio (internally), Tangent to a circle from a point outside it. Construction of a triangle similar to a given triangle.

UNIT XI: MENSURATION-2

AREAS RELATED TO CIRCLES: Area of a circle; area of sectors and segments of a circle. Problems based on areas and perimeter / circumference of the above said plane figures. (In calculating area of segment of a circle, problems should be restricted to central angle of 60° , 90° & 120° only. Plane figures involving triangles, simple quadrilaterals and circle should be taken.)

SURFACE AREAS AND VOLUMES: Problems on finding surface areas and volumes of combinations of any two of the following: cubes, cuboids, spheres, hemispheres and right circular cylinders/cones. Frustum of a cone. Problems involving converting one type of metallic solid into another and other mixed problems. (Problems with combination of not more than two different solids be taken.)

****Molecular Biology**

Concepts in Biology, Characteristics of living Organisms, Structure of Cells, Energy flow, Nutrition & Metabolism; Information storage and gene expression, Reproduction and Inheritance. Biomolecules, Carbohydrates, Amino Acids, Proteins, Lipids, Nucleic Acids. Enzymes, Properties, Activation energy, Reaction Kinetics, Intercellular Communication, DNA Expression and replication, Genes, Cloning, Mutation X-ray Crystallography, NMR Genome Organization.