

Topics of Mathematics in Final Examination

Oral Part

I. Cognitive and Thinking Methods; Sets; Logic; Combinatorics; Graphs

1. *Set Theory* Basic notions,
Set operations, properties of operations,
Applications of sets and set operations in different fields of mathematics
(number theory, geometry, etc.).
2. *Logic* Negation, conjunction, disjunction, XOR and equivalence,
Applications.
3. *Notions, definitions and theorems*
Interpretation of simple texts of mathematics,
Exact formulation of definitions and theorems,
Proper application of necessary and sufficient conditions.
4. *Combinatorics* Solution of problems.
5. *Graphs* Basic notions, demonstration of graphs,
Simple applications.

II. Number Theory; Algebra

1. *Numbers* Real numbers,
Different forms of real numbers,
Basic operations and their properties,
Exact value and approximate value, accuracy of calculations and results,
proper rounding,
Number systems, 'digits' and their meanings.
2. *Number Theory* Divisor, multiple, prime number, composite number,
Fundamental Theorem of Number Theory,
Decomposition of numbers to product of prime factors,
Greatest common divisor, Lowest common multiple, co-primes
Simple exercises of divisibility.
Number systems, other than decimal, conversions.
3. *Algebraic expressions and operations*
Operations with algebraic expressions,
Special binomial products and their applications.
4. *Powers, roots, logarithms*
Definitions, identities (with proofs), operations of powers,
Concept of logarithm, definition, consequences, Change-of-base formula,
Applications of logarithm in solution of problems.

5. Equations, inequalities

Solution of linear and quadratic equations, inequalities,
Linear and Quadratic problems, Variations, Percentages,
Irrational/radical equations, inequalities,
Exponential equations,
Simultaneous equations,
Systems of inequalities.

III. Functions

1. Functions, Graphs of functions, transformations of functions

Concept of function, different notations, Evaluation, solution.
Basic functions: direct proportion, linear, quadratic, radical functions,
inverse proportion, rational, exponential functions,
Simple transformations of basic functions: $f(x) + c$, $f(x + c)$, $c \cdot f(x)$, $|f(x)|$
Converse of one-to-one mapping.

2. Characterisation of functions

Domain, range, zeroes, y-intercept, extremes, monotonicity.

3. Sequences

Sequences in general, basic notions, definitions; recursion,
Arithmetic and geometric progressions, proofs of formulae.
Arithmetic mean and geometric mean,
Compound interest. Annuity and instalments.

IV. Geometry; Analytical Geometry; Trigonometry

1. Basic notions, different sets of points

Angle types, angle pairs, measures of angles,
Locus, special point sets,
Distance in space,
Angle of inclination of geometric elements in space.

2. Transformations

Properties of transformations,
Congruent transformations, congruency of figures,
Basic cases of congruency of triangles,
Central dilation, similarity,
Properties of similar figures,
Application of congruency and similarity in solution of simple problems.

3. Shapes of planar geometry

a) Triangles

Classification of triangles,
Definitions of parts of triangles,
Theorems involving sides, angles and
special points and lines of triangles – proofs,
Pythagorean Theorem – proof

- Application of theorems and definitions in solution of calculation or construction problems.
- b) *Quadrilaterals* Types of quadrilaterals and their properties.
- c) *Polygons* Equilateral, equiangular and regular polygons, Sum of diagonals, sum of interior angles, sum of exterior angles, Inscribed and circumscribed circles of regular polygons.
- d) *Circle* The circle and its parts, Thales' theorem - proof
Mutual positions of lines and circles.
4. *Spatial objects* Polyhedra (e.g.: cube, cuboid, tetrahedron, prism, pyramid, truncated pyramid), Cylinder, cone, frustum, sphere, hemisphere.
Area and volume calculations
5. *Perimeter, area and volume calculations*
Perimeter and area formulae of simple planar figures; calculations,
Area and volume calculations of solids,
Ratio of perimeter, area and volume of similar planar figures and solids.
6. *Vectors* Concept of vector,
Operations with vectors (sum, difference, multiplication by a scalar, dot product, linear combination),
Properties of operations,
Application of vectors.
7. *Trigonometry* General definitions of trigonometry functions,
Simple relations between trigonometry functions and values,
Law of sines – proof, law of cosines.
8. *Analytic Geometry*
Vectors in the coordinate plane, operations with vectors (sum, difference, multiplication by a scalar, linear combination),
Length/distance, midpoint, centre of circle,
Different types of equations of lines and circles,
Mutual positions of lines and circles.

V. Probability; Statistics

1. *Descriptive statistics*

Collection, organisation and representation of data,
Frequency, relative frequency, Classification of data
Measures of central tendency: arithmetic mean, weighted average, median, mode, Different types of charts. Quartiles, Box-plots
Variance and standard deviation, comparing datasets.

2. *Probability*

Definition of probability, Classic model of probability,
Mutually exclusive events, multiplying probabilities, adding probabilities;
Geometric model of probability. Sampling with/without replacement.
Expected value.