

# The Competition Syllabus - Mathematics

## Grade VII-XII

### Grade VII

#### ALGEBRA

1. The Integers' Set, The Set of Rational Numbers, The Real Numbers' Set;
2. The Module of a Real Number. Properties
3. The Integer Part and Fractional Part of a Real Number, Rules for Calculating the Radicals
4. The Algebraic Calculation, Calculations with Real Numbers represented by Letters (including the identity of Lagrange, Cauchy inequality - Buniakovski - Schwarz).

#### GEOMETRY

1. Quadrilateral (curriculum content).
2. Collinearity problems. Competition concerns.
3. Triangle similarity  
Thales's theorem. Reciprocal Theorem of Thales's theorem. Equidistant parallel theorem. Non-equidistant parallel theorem. Middle line in the triangle; Properties. The Center of gravity in a triangle; Properties. The Middle line in the trapezoid, Properties. The Fundamental theorem of similarity. Criteria for similarity of triangles. The Bisector theorem (interior and exterior) and The Converse Theorem. The Menelaos's theorem, The Converse Theorem. The Ceva's theorem, The Converse Theorem.

### Grade VIII

#### ALGEBRA

1. Real Numbers  
Integer Part and Fractional Part of a Real Number. Equations. The Module of a Real Number. Equations. Intervals. Intersection and Meeting Intervals. Rationalizing the Denominator of the form  $a\sqrt{b}$  and  $a \pm \sqrt{b}$ ,  $a, b \in N$ . Short formulas. Reports of real numbers represented by letters. Operations.

#### GEOMETRY

1. The Circle  
Definition. Elements in a circle. Angle at the center. The Measure of the Arcs. Strings and arcs; properties. The theorem of the Angle inscribed in a circle. Inscribed circle, a triangle circumscribed circle. Orthodiagonal quadrilateral. Inscribed quadrilateral writable. Circumscribed Quadrilateral. Inscribe conditions, circumscribe conditions. The Euler circle. The Relative positions of a line to a circle. The Relative positions of two circles. The Arc theorem capable of a given angle. Regular polygons. The Length of the circle and the arc of circle. The Disc area and the circular sector.
2. Geometric inequalities. Problems of Maximum and minimum.  
The Triangle inequality. In a triangle, the greater side angle opposes higher angle and vice versa. The Perpendiculars and Obliques theorem.
3. Simple constructions with ruler and non degreed compass.
4. Elementary geometrical locus problems.
5. Points, lines, planes. Parallelism.  
To The curriculum content are also added: Theorems of parallelism, Menelaos's theorem in space, Menelaos's theorem converse, Thales' theorem in space, the symmetry axis of the rectangular parallelepiped, axis of symmetry of regular quadrilateral pyramid, symmetry to a plan; axial sections in the bodies which admit symmetry axes.

## 6. Orthogonal projections on a plane

To the curriculum content are also added added: common perpendicular to two straight, three perpendicular reciprocal theorem; mediated plan; leap plan.

Note:

The Correct use in writing by students of the solution of some theorems (without demonstration): Steiner's theorem, Ptolemy's theorem, Fermat's theorem and the principle of mathematical induction, etc.) leads to maximum scoring scales provided in corrective.

## Grade IX

### ALGEBRA

- 1.Elements of logic and the set theory
- 2.Functions defined on the set of natural numbers
- 3.Functions. Reading graphs
- 4.First degree function
- 5.Second degree function.

The following notions and results are part of supplementary curriculum for the county phase:

- 1.Equations in whole numbers:  $ax + by = c$ ;  $x^2 + y^2 = z^2$ , (Pell's equation)
2. The theorem of the division with rest for the integers set.
3. Euclid algorithm.
4. Euler indicator (the number of the prime numbers with n smaller than n )
- 5.Congruence modulo n
- 6.Theorems of: Euler, Fermat, Wilson.
- 7.Sets. The Characteristic function of the set. The principle of inclusion and exclusion
8. Averages inequality. Inequality of Cauchy-Buniakovski. Holder's inequality. Bernoulli's inequality. Cebîşev's inequality.
- 9.Injective, surjective, bijective functions.
- 10.Linear recurrence order I and II, homographic recurrences.

### GEOMETRY AND TRIGONOMETRY

- 1.Vectors in the plane
2. Colliearity , competition, parallelism – vector calculation in plane geometry
- 3.Elements of trigonometry

The following notions and results are part in the county phase: classical geometry theorems. Stewart's Theorem. Van Aubel's theorem. Steiner's theorem. Euler line. Simson straight type, etc.. Important points and lines. Theorems and colliearity competition. Metric relations.

## Grade X

### ALGEBRA

- 1.Sets of numbers
- 2.Functions and equations
- 3.Counting methods
- 4.Convexity in the sense of Jensen.

### GEOMETRY

The whole curriculum.

## Grade XI

### ALGEBRA AND GEOMETRY

1. Elements of linear algebra and analytical geometry (until solving linear systems - only).

The following notions and results are part of supplementary curriculum for the county phase:

1. The Division of permutations into disjunction cycles products, respectively transpositions.
2. Determinant of order  $n$ .
3. Laplace's rule.
4. Hamilton-Cayley theorem.
5. Rank of a matrix  $M_{n,m}(C)$ .
6. Sylvester's inequality on the rank product of two matrices.

### MATHEMATICAL ANALYSIS

1. The set of real numbers.
2. Series of real numbers.
3. Limited functions.
4. Continuous functions.

The following notions and results are part of supplementary curriculum for the county phase:

1. Open, closed, compact sets and  $\mathbb{R}$  density.
2. Numberability,  $\mathbb{Q}$  numberability,  $\mathbb{R}$  numberability.
3. Limited points for series.
4. Upper and lower limit on series.
5. Function oscillation on a set, discontinuities of the first and second case.
6. Uniform continuity.
7. Functions with intermediate value property (Darboux's property).

Note:

Correct use by students in writing the solution of theorems without demonstration during the Olympics leads to maximum scoring scales provided in corrective.

## Grade XII

### ALGEBRA

1. Elements of algebra (up to fixtures - included)

The following notions and results are part of supplementary curriculum for the county phase: finite groups. Lagrange's theorem. Cauchy's theorem. Direct product structure. Morphisms of structures (semigroup, monoids, etc). Finite groups generated. The group of permutations, cycles, decomposition product of disjoint cycles. Classical subgroups (the center of a group Synoptic a set, kernel and image of a morphism). Elements and Nilpotent and idempotent elements. Any finite body is commutative.

### MATHEMATICAL ANALYSIS

1. Elements of mathematical analysis (to the center of gravity-inclusive)
2. Darboux sums, Riemann sums, integrability.

Note:

The Correct use by students in writing of the solution of theorems without demonstration during the program of the Olympics leads to maximum scoring scales provided in corrective.