

Mathematics Entrance Exam: Guidelines and Syllabus

General Information

- Mandatory for all first-cycle programs
- **Format:** Online via Microsoft Teams.
- **Duration:** 120 minutes.
- **Passing Threshold:** Minimum 50% of the total available points.
- **Standard:** Advanced secondary school mathematics (comparable to GCE A-Level, IB Analysis & Approaches, or Polish Extended Matura; includes algebra, analytic geometry, and single-variable calculus).
- **Attendance Policy:** Failure to attend the exam results in 0 points.
- **Results:** Published directly to candidate accounts via the IRK online admission system.

Technical and Organizational Rules

- **Check-in:** Candidates must log in 15 minutes before the scheduled start time and present a valid photo ID to the camera for verification.
- **Camera and Workspace:** The candidate's face, hands, and workspace must remain clearly visible on camera throughout the entire examination.
- **Supervision:** The Examination Board reserves the right to request a 360° camera rotation or screen sharing at any point if academic dishonesty is suspected.
- **Materials and Devices:** Only materials explicitly provided or approved by the Examination Board are permitted. All other electronic devices (including smartphones and smartwatches) must be switched off.
- **Submitting Answers:** Open-ended tasks must be scanned or photographed and uploaded through the designated platform as PDF or JPG files immediately upon completion.

Exam Syllabus

1. Real Numbers

- Properties of operations on real numbers.
- Powers with rational and real exponents.
- Radicals and logarithms; transforming algebraic and logarithmic expressions.
- Solving equations and inequalities involving powers and logarithms.

2. Algebraic Expressions

- Simplification and manipulation of algebraic expressions.
- Short multiplication formulas (algebraic identities).
- Factoring polynomials, polynomial arithmetic, and polynomial long division.
- Vieta's formulas.
- Systems of linear and non-linear equations (algebraic and graphical methods).

3. Equations and Inequalities

- Linear, quadratic, rational, exponential, and logarithmic equations and inequalities.
- Absolute value inequalities.
- Systems of equations and inequalities.
- Parametric equations and applications of Vieta's formulas.

4. Functions

- Function properties: monotonicity, parity (even/odd), periodicity.
- Elementary functions: linear, quadratic, exponential, logarithmic, trigonometric.
- Function graphing and transformations.
- Roots (zeros), absolute and local extrema.
- Mathematical modeling using functions.

5. Trigonometry

- Trigonometric functions for acute angles and general angles.
- Reduction formulas and fundamental trigonometric identities.
- Trigonometric equations and inequalities.

- Geometric applications of trigonometry.

6. Sequences and Series

- Arithmetic and geometric progressions (general terms and sums).
- Limits of sequences; convergent and divergent sequences.
- Infinite geometric series.

7. Calculus

- Limits of functions.
- Derivatives and their geometric interpretation (tangent lines).
- Differentiation of elementary functions.
- Applications of derivatives (curve sketching, intervals of monotonicity, local extrema).
- Basic indefinite and definite integrals.

8. Geometry (Planar, Analytic, and Solid)

- Properties of plane figures (triangles, quadrilaterals, circles).
- Length, area, and angle calculations using trigonometry.
- Analytic geometry: equations of lines and circles, distance between a point and a line.
- Solid geometry: prisms, pyramids, cylinders, cones, spheres (surface areas and volumes).

9. Stereometry (3D Geometry)

- Metric relations in three-dimensional space.
- Angles between lines, lines and planes, and dihedral angles between planes.

10. Combinatorics, Probability, and Statistics

- Permutations, combinations, and variations.
- Classical and conditional probability; probability trees.
- Binomial distribution.
- Descriptive statistics: mean, median, standard deviation.

11. Elements of Logic and Set Theory

- Set operations, subsets, and Venn diagrams.

- Propositional logic, logical connectives, and quantifiers.
- Methods of mathematical proof (including mathematical induction).