MATH DEPARTMENT

Year of 2026-2027

Lessons required for the Math Entrance Exam: (Grade 11S to 12LS-GS)

*Calculator is needed.

1. **Quadratic Equations**

   Students should be able to:

   - Solve complete and incomplete quadratic equations.
   - Find two real numbers whose sum S and product P are given ($x^2 - Sx + P = 0$).

2. **Quadratic Inequalities**

   Students should be able to:

   - Study the sign of a quadratic function.
   - Solve quadratic inequalities with one unknown.
   - Solve a system of quadratic inequalities with one unknown.

3. **Polynomials**

   Students should be able to:

   - Divide two polynomials using the Euclidean division.
   - Factorize a second degree polynomial.
   - Factorize a third degree polynomial knowing a root (using identification method and long division).

4. **Limits**

   Students should be able to:

   - Find the Limit of functions as x tends to $\pm\infty$ and a real number.
   - Deduce horizontal and vertical asymptotes to a curve of a function from its limits.
   - Study the continuity of a function at a certain point.

5. **Derivatives**

   Students should be able to:

   - Study the differentiability of a function using the limit definition of derivative.

- Find the derivative of a function using differentiation rules.
- Study the sense of variation of a function by studying the sign of its derivative.

6. <u>Antiderivatives:</u>

Students should be able to:

- Prove that a given function is an antiderivative of a function.
- Find the antiderivatives of a given function.
- Find the antiderivative of a function verifying a certain condition.
- Apply properties of linearity for antiderivatives.

7. <u>Study of Polynomial and Rational Functions</u>

Students should be able to:

- Evaluate limits at the open boundaries of the domain of definition of a polynomial/rational function.
- Study the Sense of Variations of given functions (draw table of variations and locate the local extrema).
- Find an equation of a tangent to the curve of a function at a point on the curve.
- Show that a given line is an oblique asymptote to the curve of a rational function.
- Study the relative positions of a curve and its oblique asymptote.
- Prove a given line as an axis of symmetry to the curve of a function.
- Prove a given point as a center of symmetry to the curve of a function.
- Graph the curve of a function.
- Solve equations and inequalities graphically.

8. <u>Counting</u>

Students should be able to:

- Calculate Factorials.
- Count possibilities using the product principle.
- Solve counting problems of sampling with replacement (r-list).
- Solve counting problems of sampling without replacement (permutation).
- Use combinations to solve counting problems in which order doesn't matter. (basic level)

9. <u>Probability</u>

Students should be able to:

- Calculate the Probability of an event in the case of equally likely events.
- Calculate the probability of complementary events, event A or B ($A \cup B$) and event A and B ($A \cap B$).
- Compute basic conditional probability.

10. Orthogonality in Space

Students should be able to:

- Study the relative positions of two lines/two planes and a line and a plane in space including orthogonality.
- Find the intersection point or line between 2 lines/a plane and a line or 2 planes.
- Prove the mediator plane of a segment.
- Use properties of parallelism and orthogonality to solve spatial geometry problems.

11. Vectors and Systems of the Space:

Students should be able to:

- Find the coordinates of a point and a vector (in addition to product of a vector by a real number and sum of two vectors) in a system of space formed of an origin and reference axes.
- Plot a point in a system of the space.
- Prove vectors collinear/coplanar/equal/orthogonal.
- Find the coordinates of points/vectors in a translated coordinate system of the space by applying rules of translation.

12. Oriented Angles

Students should be able to:

- Find a unit vector.
- Find oriented angles between 2 vectors and 2 lines.
- Apply the relations between oriented angles.
- Draw direct and indirect geometric figures (triangles, squares…).

13. Trigonometric Equations

Students should be able to:

- Solve equations of the form: $\cos x = a,\ \sin x = a\ \ and\ \ \tan x = a.$
- Find the polar coordinates of a point.
- Change from Cartesian to Polar coordinates and vice versa.

14. <u>Trigonometry 2: Formulas of Addition and Transformation</u>

Students should be able to:

- Simplify expressions including the forms: $\cos(\mathrm{a}-\mathrm{b})$, $\cos(\mathrm{a}+\mathrm{b})$, $\sin(\mathrm{a}-\mathrm{b}), \sin(\mathrm{a}+\mathrm{b}), \tan(a-b), \tan(a+b), \cos(2a), \sin(2a)$ and tan(2a).
- Use transformation formulas of a product to a sum (linearization): $\sin a\, sinb$, cosacosb, sinacosb

15. <u>Circles</u>

Students should be able to:

- Write an equation of a circle given its characteristics.
- Find the center and radius of a circle given its equation.