

Math

Requirements for applicants by Innopolis University

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1: Algebra

1.1 Numbers, roots and exponents

- Integer numbers
- Positive integer exponents
- Fractions, percentage, rational numbers
- Integer exponents
- Nth roots with $n > 1$ and their properties
- Rational exponents and their properties
- Properties of real exponents

1.2 Basics of trigonometry

- Sin, cos, tan, cot of an arbitrary angle
- Radian measure of the angle
- Sin, cos, tan, cot of a number
- Basic trigonometric identities
- Shift, symmetry, periodicity
- Sin, cos, tan of sum and difference of two angles
- Sin and cos of a double-angle

1.3 Logarithms

- Logarithm of a number
- Logarithm of product, quotient and power
- Decimal and natural logarithm, e number

1.4 Transformations of expressions

- Transformations of expressions with arithmetic operations
- Transformations of expressions with exponentiation
- Transformations of expressions with nth roots
- Transformation of trigonometric expressions
- Transformations of expressions with logarithms
- Absolute value of a number

2: Equations and inequalities

2.1 Equations

- Quadratic equations
- Rational equations
- Irrational equations
- Trigonometric equations
- Exponential equations
- Logarithmic equations
- Equivalent equations and equivalent systems of equations
- Systems of equations with two unknowns
- Basic methods of solving systems of equations: substitution, algebraic addition, change of variables
- Solving equations using properties of functions and their graphs
- Plotting the solution set of equations with two unknowns and systems of equations
- Application of mathematical methods for solving real life and scientific problems. Interpretation of the result, with respect to limitations

2.2 Inequalities

- Quadratic inequalities
- Rational inequalities
- Exponential inequalities
- Logarithmic inequalities
- Systems of linear inequalities
- Systems of inequalities with one unknown
- Equivalent inequalities and systems of inequalities
- Solving inequalities using properties of functions and their graphs method of intervals
- Plotting the solution set of inequalities with two unknowns and systems of inequalities

3: Functions

3.1 The definition of a function

- Function, the domain of a function
- Codomain of a function
- Graph of a function. Examples of functional relation in real life
- The inverse function and its graph.
- Transformation of graphs: shifting, reflecting

3.2 Basic investigation of a function

- Monotonicity of a function. Increase and decrease intervals of a function
- Odd and even functions
- Period of a function
- Limits of a function
- Extremum points of a function
- Maximum and minimum values of a functions

3.3 Elementary functions

- Linear function and its graph
- The inverse proportional function, its graph
- Quadratic function and its graph
- Power function (natural case) and its graph
- Trigonometric function and its graph
- Exponential function and its graph
- Logarithmic function and its graph

4: Introduction to Calculus

4.1 Derivative

- Derivative of a function, geometric interpretation of the derivative
- Physical interpretation of the derivative, finding the speed of the process that defined by a formula or a plot
- Equation of tangent line
- Derivatives of sum, difference, product and quotient
- Derivatives of basic elementary functions
- Second derivative and its physical interpretation

4.2 Curve sketching

- Curve sketching using derivative
- Examples of finding the best solution to engineering problems using derivative
- Antiderivative and Integral
- Antiderivatives of elementary functions
- Examples of using the integral in physics and geometry

5: Geometry

5.1 Planimetrics

- Triangle
- Parallelogram, rectangle, diamond, square
- Trapezoid
- Circle
- Circle inscribed in a triangle and triangle inscribed in circle
- Polygon. Sum of angles of convex polygon
- Regular polygon. Circle inscribed in a right polygon and right polygon inscribed in circle

5.2 Line and planes in space

- Overlapping, parallel, skew and perpendicular lines
- Line parallel to a plane
- Parallel planes
- Line perpendicular to a plane, perpendicular and theorem of three perpendiculars
- Perpendicular planes
- Parallel projecting. Image of dimensional figures

5.3 Polyhedron

- Prism, its bases, edges, height, faces; regular prism
- Parallelepiped; cube; symmetry in cube and parallelepiped
- Pyramid, its base, edges, height, faces; regular pyramid
- Cube sections, prisms, pyramids
- Regular polyhedrons (tetrahedron, cube, etc.)

5.4 Solid and surface of revolution

- Cylinder. Base, height, face
- Cone. Base, height, face
- Ball, sphere, their sections

5.5 Measurement of geometrical quantities

- Measurement of angle, measurement of angle in degrees, measurement of angle and length of an arc of a circle
- Angle between lines in space; angle between line and plane, angle between planes
- Length of a line segment, length of a circle, perimeter of polygon
- Distance from point to line, from point to plane, distance between parallel and skew lines, distance between parallel planes
- Area of a triangle, parallelogram, trapezoid and sphere
- Surface area of cone, cylinder, sphere
- Volume of cube, parallelepiped, pyramid, prism, cylinder, cone and ball

5.6 Coordinates and vectors

- Line's coordinates, Cartesian coordinates
- Formula of distance between two points; sphere equation
- Vector, equality of vectors; sum of vectors and multiplying vector by a number
- Collinear vectors. Decomposition of vector by two noncollinear vectors
- Coplanar vectors. Decomposition of vector by three non-coplanar vectors
- Coordinates of vector; dot product of vectors; angle between vectors

6: Combinatorics, Statistics and Probability theory

6.1 Combinatorics

- Alternate and simultaneous choices
- Number of arrangements and combinations. Binomial theorem

6.2 Statistics

- Representation of data by table and plot
- Numerical characteristics of data series

6.3 Probability theory

- Probability of an event
- Examples of finding the solution to engineering problems using probability and statistics

7: Additional topics

- Definition of assertion
- Definition of predicate
- Assertion and predicate operation
- Sets and operation with them
- Subsets and supersets
- Quantifiers in the predicates with one variable
- Method of mathematical induction
- Combinatorics elements. Multiplication and addition rules
- Permutation, assignment and compromise