Syllabus for the Post of TGT Maths -Physics

MATHEMATICS

1. Real Numbers

- **Number Representations:** Representation of natural numbers, integers, and rational numbers on the number line. Rational numbers as recurring/terminating decimals. Operations on real numbers.
- **Irrational Numbers:** Examples of non-recurring/non-terminating decimals. Existence of irrational numbers (e.g., $\sqrt{2}$, $\sqrt{3}$) and their representation on the number line. Unique representation property: every real number corresponds to a unique point on the number line and vice versa.
- **Radicals & Rationalization:** Definition of the nth root of a real number. Rationalization of expressions of the form $1 / (a + b\sqrt{x})$ and $1 / (\sqrt{x} + \sqrt{y})$ and their combinations, where $x, y \in \mathbb{N}$ and $a, b \in \mathbb{Z}$.
- **Exponents & Fundamental Theorem of Arithmetic:** Laws of exponents with integral powers. Rational exponents with positive real bases. Fundamental Theorem of Arithmetic (statements, examples, and motivation). Proofs of irrationality for $\sqrt{2}$, $\sqrt{3}$, and $\sqrt{5}$.
- **Number Theory, Patterns & Algorithms:** Sequences and patterns; triangular, hexagonal, square, and cube numbers; shape sequences, super cells, and palindromic patterns. Kaprekar constant, clock and calendar numbers, Collatz conjecture. Brahmagupta's method of computation.

2. Polynomials

- **Definitions & Basic Concepts:** Definition of a polynomial in one variable (with examples and counterexamples). Coefficients, terms, and zero polynomial. Degree of a polynomial. Constant, linear, quadratic, and cubic polynomials. Monomials, binomials, and trinomials. Factors and multiples.
- **Zeros & Factorization:** Zeros of a polynomial. Relationship between zeros and coefficients of quadratic polynomials. Remainder Theorem (with examples) and Factor Theorem. Factorization of $ax^2 + bx + c$ ($a \neq 0$, where $a, b, c \in \mathbb{R}$) and cubic polynomials using the Factor Theorem.
- **Algebraic Identities & Applications:** Key algebraic identities and their applications in polynomial factorization:
  - $(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$
  - $(x \pm y)^3 = x^3 \pm y^3 \pm 3xy(x \pm y)$
  - $x^3 \pm y^3 = (x \pm y)(x^2 \mp xy + y^2)$
  - $x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$

3. Matrices & Vector Spaces

- **Vector Spaces:** $\mathbb{R}$, $\mathbb{R}^2$, and $\mathbb{R}^3$ as vector spaces over $\mathbb{R}$, and the general concept of $\mathbb{R}^n$. Standard basis for $\mathbb{R}$, $\mathbb{R}^2$, $\mathbb{R}^3$. Linear independence and examples of different bases. Subspaces of $\mathbb{R}^2$ and $\mathbb{R}^3$.
- **Geometric Transformations:** Translation, dilation, rotation, and reflection in a point, line, and plane. Matrix representation of basic geometric transformations. Geometric interpretation of eigenvalues, eigenvectors, and eigenspaces as invariant subspaces.
- **Matrix Operations:** Matrices in diagonal form. Reduction of matrices up to order 3 to diagonal form. Computation of matrix inverses using elementary row operations. Rank of a matrix. Solutions of systems of linear equations using matrices.

4. Linear Equations in Two Variables

- Linear equations in one variable. Introduction to linear equations in two variables, focusing on ax + by + c = 0. Infinitely many solutions of linear equations in two variables; writing solutions as ordered pairs of real numbers, plotting them, and showing they form a straight line.

5. Pair of Linear Equations in Two Variables

- Pair of linear equations in two variables and their graphical solution. Consistency vs. inconsistency. Algebraic conditions for the number of solutions.
- **Algebraic Methods of Solution:** Substitution and Elimination. Simple situational word problems.

6. Quadratic Equations

- **Standard Form:** $ax^2 + bx + c = 0$ ($a \neq 0$).
- **Solutions:** Solutions of quadratic equations (real roots only) by factorization and the quadratic formula.
- **Discriminant:** Discriminant and the nature of roots.

7. Arithmetic Progressions (AP)

- Definition of Arithmetic Progression.
- nth term and sum of the first n terms of an AP.
- Application in solving daily life problems.

8. Coordinate Geometry

- Cartesian plane, coordinates of a point, terminology, and notations. Graphs of linear equations.
- Distance formula, Section formula (internal division), and Area of a Triangle.

9. Introduction to Euclid's Geometry

- History of geometry in India and Euclid's geometry.
- Formalization of observed phenomena into rigorous mathematics using definitions, common notions, axioms/postulates, and theorems.
- The five postulates of Euclid. Relationship between axioms and theorems (e.g., Axiom: Given two distinct points, exactly one line passes through them; Theorem: Two distinct lines cannot have more than one point in common).

10. Lines and Angles

- **Linear Pair Axiom:** If a ray stands on a line, the sum of two adjacent angles formed is 180° (and converse).
- **Theorems:** Vertically opposite angles theorem.
- **Parallel Lines:** Lines parallel to the same line are parallel to each other.

11. Triangles

- **Congruence Criteria:** SAS, ASA, SSS, and RHS congruence criteria.
- **Properties of Triangles:** Angles opposite to equal sides are equal, and sides opposite to equal angles are equal.

- **Similarity & Proportionality Theorems:** Key theorems and criteria:
  - Basic Proportionality Theorem (Thales's Theorem) and its converse.
  - AAA / SSS / SAS similarity criteria and their proofs/applications.

12. Quadrilaterals

- Diagonal divides a parallelogram into two congruent triangles.
- **Properties of Parallelograms:** Opposite sides/angles are equal (and converses). Conditions for a quadrilateral to be a parallelogram (e.g., one pair of opposite sides is equal and parallel). Diagonals of a parallelogram bisect each other (and converse).
- **Mid-point Theorem:** Line segment joining mid-points of two sides of a triangle is parallel to the third side and half of it (and converse).

13. Circles

- Equal chords subtend equal angles at the center (and converse).
- Perpendicular from center to a chord bisects the chord (and converse).
- Equal chords are equidistant from the center (and converse).
- Angle subtended by an arc at the center is double the angle subtended by it at any point on the remaining circle.
- Angles in the same segment of a circle are equal. Concyclic points criterion.
- Sum of opposite angles of a cyclic quadrilateral is 180° (and converse).
- **Tangent Properties:** Tangent is perpendicular to the radius at the point of contact; lengths of tangents from an external point are equal.

14. Areas

- Area of a triangle using Heron's formula.
- Area of sectors and segments of a circle (central angles restricted to 60°, 90°, and 120°).
- Problems involving perimeter and areas of plane figures.

15. Surface Areas and Volumes

- Surface areas and volumes of spheres, hemispheres, and right circular cones.
- Combinations of two solids: cubes, cuboids, spheres, hemispheres, and right circular cylinders/cones.
- Application of Heron's formula in finding the area of a quadrilateral.

16. Statistics

- **Graphical Representations:** Bar graphs, histograms (with varying base lengths), and frequency polygons.
- **Measures of Central Tendency:** Mean, median, and mode of grouped and ungrouped data.
- **Data Presentation:** Presentation of data in tabular form and infographics.

17. Probability

- Classical definition of probability and simple event probability problems.
- Elementary probability and basic laws.
- Discrete and continuous random variables.

18. Trigonometry

- **Ratios:** Trigonometric ratios of an acute angle in a right triangle; proofs of existence. Ratios defined at 0° and 90°. Values for 30°, 45°, and 60°. Inter-relationships between ratios.
- **Identities:** Proof and applications of $\sin^2 A + \cos^2 A = 1$.
- **Heights and Distances:** Angles of elevation and depression. Simple problems involving no more than two right triangles with angles 30°, 45°, and 60°.

19. Calculus

- **Functions & Limits:** Sets; polynomial, sine, cosine, exponential, logarithmic, and step functions along with their graphs. Limits and continuity.
- **Differentiation:** Methods of differentiation (Chain rule, Product rule, Quotient rule). Second-order derivatives of standard functions.
- **Integration:** Integration as the reverse process of differentiation; basic integrals.

20. Inequalities

- Elementary inequalities and absolute value inequalities.
- Inequality of Means (AM-GM-HM).
- Cauchy-Schwarz Inequality.
- Chebyshev's Inequality.

PHYSICS

1. Motion

- Distance and displacement, velocity.
- Uniform and non-uniform motion along a straight line; acceleration.
- Distance-time and velocity-time graphs for uniform and uniformly accelerated motion.
- Elementary idea of uniform circular motion.

2. Force and Newton's Laws

- Force and motion; Newton's Laws of Motion.
- Action and reaction forces.
- Inertia of a body, relation between inertia and mass.
- Momentum, force, and acceleration.

3. Gravitation

- Universal Law of Gravitation.
- Gravitational force of the Earth (gravity) and acceleration due to gravity (g).
- Mass vs. weight; free fall.

4. Floatation

- Thrust and pressure.
- Archimedes' Principle and buoyancy.

5. Work, Energy, and Power

- Work done by a force.
- Energy and power; Kinetic energy and Potential energy.
- Law of Conservation of Energy.

6. Sound

- Nature of sound and its propagation in various media.
- Speed of sound; human range of hearing; ultrasound.
- Reflection of sound and echo.

7. Effects of Current

- Electric current, potential difference, and Ohm's law.
- Resistance, resistivity, and factors affecting conductor resistance.
- Series and parallel combinations of resistors and their daily life applications.
- Heating effect of electric current and its applications; electric power (P, V, I, R relations).

8. Magnetic Effects of Current

- Magnetic field and field lines.
- Field due to a current-carrying conductor, coil, and solenoid.
- Force on a current-carrying conductor and Fleming's Left-Hand Rule; Electric Motor.
- Electromagnetic induction, induced potential difference, induced current, and Fleming's Right-Hand Rule.
- Electric Generator, Direct Current (DC), Alternating Current (AC) and its frequency.
- Advantages of AC over DC; domestic electric circuits.