

Topics in Level 4 - Out Of The Box Thinking

Total number of Topics: 20.

Net Lecture Duration: 30 hours

Syllabus:

- **CHASING THE RATIOS**

Here is an interesting topic on descriptive geometry, also called construction geometry, which finds numerous applications in Architecture and Civil Engineering. Basic constructions of triangles with specified angles, based on ratios of sides are derived, by combining simple standard right and equilateral triangles. This also leads to ratios of sides and diagonals of polygons.

Outcomes: Effective use of Pythagoras theorem, similarity and dissection of triangles into standard right triangles.

- **WHAT'S YOUR CHANCE?**

From games of chance, the theory of probability evolved. The fundamental rules of probability and its applications are introduced. Conditional probability and Baye's theorem are visited. These find a multitude of applications in Finance, Medicine and Business. Discrete and continuous probabilities are also introduced. Interesting problems on geometric probability are solved.

Outcomes: Effective use of probability in problem-solving. Good command of Baye's theorem and its applications

- **TRANSFORMATION GEOMETRY**

Basic two-dimensional transformations like translation, rotation, reflection, and scaling are presented. Effective use of this in solving Euclidean Geometry and coordinate geometry is exemplified through problems. These are used in complex numbers also.

Outcomes: Manipulating geometric objects using transformations.

- **THE GRAPHMAN (FUNCTIONS)**

This is very essential for Calculus. The graphs of functions, and their characteristics like periodicity, continuity, smoothness, curvature, symmetry about a line, and symmetry about a point are emphasized. The features of a one-to-one function and a bijective function are presented. Problems testing these concepts are solved and assigned.

Outcomes: Recognizing the characteristics of a function from the graph and vice versa.

- **COLORING MATH**

Here, many problems where points in a geometrical object or a plane, are coloured using two or three colours and questions regarding certain geometrical objects are raised. Many questions in combinatorics can be solved using colouring. Covering planar objects, problems

using polyominoes can be solved using colouring.

Outcomes: Mapping from one domain to another as a means of solving problems

- **FRIENDLY TRIGONOMETRY**

Inverse trigonometric ratios and properties are introduced. Evaluating trig ratios for some non-standard angles presented in multiple methods.

Outcomes: Alternate ways of finding trig ratios and use of Geometry.

- **DR. CALCULUS**

Continuity, Differentiability, Integration, and properties thereof are presented. Mean value theorems in Differentiation and Integration are explained through problems.

Outcomes: Knowledge of mean value theorems.

- **PLAYING THE SERIES**

Series different from sequence emphasized. Convergence concepts, telescopic series, and interesting problems from Olympiads where these techniques are used are discussed.

Outcomes: Effective use of collapsing of series.

- **GATEWAY TO CONIC CAVES**

We enter the world of conics – circle, parabola, ellipse and hyperbola. Common techniques are clubbed together to reduce the load. A different approach to looking at these objects is presented.

Outcomes: Conics conquered.

- **VECTOR – THE POWERFUL ARROW**

A new way of dealing with Geometry is vector algebra, where 3-D is easily realised. Three-dimensional objects can be represented and manipulated conveniently using arrow algebra. This scores over the other geometries in this respect. A simpler use of 2-D transformations can be seen here.

Outcomes: Alternate solution methods to geometric problems, use of a powerful tool in problem-solving.

- **TRAVEL WITH CO-ORDINATES**

Co-ordinate geometry in all its power is dealt with here. We discuss pre-conic geometry – lines, pairs of straight lines and properties thereof. How are co-ordinates useful in solving pure geometry questions is addressed here.

Outcomes: Solving problems in coordinate geometry with ease.

- **IS IT POSSIBLE?**

Existential questions are discussed here. Some configurations in geometry as well as some arithmetic problems may not have a solution. These questions are addressed. Proof is essential in these problems, not just a yes or no answer.

Outcomes: Comparing opinions with facts leads to better assessment skills.

- **IMAGINE THE COMPLEX**

A number line is extended to a number plane by way of complex numbers. This extension of real numbers solves algebraic equations. It is of great help in transformation geometry as,

translation, rotation, scaling are easily represented. An essential tool of higher mathematics.
Outcomes: Familiarity with the use and applications of complex numbers.

- **INDUCTION – THE RELAYMAN**

Mathematical induction proves that we can climb as high as we like on a ladder if we can step onto the bottom rung (the basis) and from there to each successive rung. As a technique, it is powerful as it can be applied in multiple domains. This is shown by way of various problems.

Outcomes: Effective use of various induction techniques.

- **THE ART OF COUNTING – 1**

Continuing from basic counting, we learn a wider range of techniques like arrangement, selection, and distribution of objects. Counting involves the bijection technique, wherein we map a given problem into a known domain and count. An important component of Olympiads.

Outcomes: A strong foundation in error-free counting

- **THE ART OF COUNTING – 2**

The pigeonhole principle and principle of inclusion-exclusion are the additional topics studied here. Interesting Olympiad problems will be discussed.

Outcomes: Effectively Solving entry-level Olympiad problems

- **DRIVING ALGEBRA**

It focuses on the effective use of algebraic inequalities through math olympiad problems.

Outcomes: Develop boundary estimation skill

- **RECURSION**

This topic helps us to learn recursions, recurrence relations and its useful applications

Outcomes: Understanding that recursion is the reverse of induction. Recursion as a programming tool.

- **A JOLLY RIDE WITH MODULO**

The topic explains modulo theory (an important branch of number theory) and its applications. Very interesting problems are dealt with.

Outcomes: Learning the power of cyclic remainders in number theory.

- **COLLECTING SPECIAL NUMBERS**

This topic is about tracing and collecting special numbers given their properties. It involves the effective use of algebra and number theory.

Outcomes: Stimulates the curiosity for such solving process.

- **MIXED BAG**

Miscellaneous problems are dealt with from various topics here.

Outcomes: Enhances multiple skills.