

## **COURSE OUTLINE**

### **NATIONAL UNDERGRADUATE MATHEMATICS CONTEST**

**Department of Mathematics, University of the Punjab, Lahore**

**Saturday, October 1, 2022**

### **CALCULUS**

Functions, Limits of functions, Continuous functions, Role of limits in the definition of derivatives and integrals, Mean value theorems, Bounded sets, Convergence of sequences and series, Computations and applications of definite integrals to compute areas and volumes.

### **COMPLEX ANALYSIS**

Complex numbers, Analytic and harmonic functions, Cauchy's fundamental and integral theorems, Singularities and residues.

### **LINEAR ALGEBRA**

Matrix algebra, System of linear equations, Vector spaces, Spanning sets, Linear dependence and basis, Linear transformations and matrices, Rank and nullity of linear transformations.

### **GROUP THEORY**

Groups, Generators and relations, Lagrange's theorem and consequences, Conjugacy classes and quotient groups, Automorphism group of a group,  $p$ -group and Sylow- $p$  subgroups, Applications of Sylow's theorems.

### **TOPOLOGY**

Basic definition of topology, Examples of topology, Standard topology on  $\mathbb{R}$ , Co-finite topology on  $\mathbb{R}$ , Relative topology, Interior, Closure and limit point of a subset of topological space, Basis and sub-basis of topology.

## **ORDINARY DIFFERENTIAL EQUATIONS**

Familiarity with different techniques for solution of first and second order differential equations, Linear and non-linear differential equations, Exact equations, Integrating factors, Homogeneous and non-homogeneous differential equations, Wronskian and singular points.

## **VECTOR ANALYSIS**

Vector algebra, Limit, Continuity and differentiability of scalar and vector point functions, Vector operators and related identities, Applications to geometry, Line integrals, Surface and volume integrals, Integral theorems.

## **MECHANICS**

Newton's laws, Concurrent forces, Conditions of equilibrium, Couple, Constrained and free motion, Virtual Work, Projectile motion, Work, Power, Kinetic energy, Potential energy, Conservative and non-conservative force fields, Impulse, Torque, Kepler's laws of planetary motion, Centre of mass and gravity.