Syllabus for the Entrance Test

Mathematics:

Linear Algebra: Elements of set theory. Vector space, subspace and its properties. Linear independence and dependence of vectors. Matrices, rank of a matrix, reduction to normal forms, linear homogeneous and non-homogeneous equations. Cayley-Hamilton theorem, characteristic roots and vectors. De Moivre's theorem, relation between roots and coefficient of n^{th} degree equation. Solution to cubic and biquadratic equation.

Calculus: Limit and continuity, differentiability of functions, successive differentiation. Leibnitz's theorem, partial differentiation. Euler's theorem on homogeneous functions. Tangents and normals, asymptotes, singular points, curve tracing, reduction formulae. Integration and properties of definite integrals, quadrature. Rectification of curves. Volumes and surfaces of solids of revolution.

Differential Equations: Linear, homogeneous, separable equations. First order higher degree equations, algebraic properties of solutions. Linear homogeneous equations with constant coefficients. Solution of second order differential equations.

Statistics:

Probability and Sampling Distributions: Notions of sample space and probability. Theorems on probability. Combinatorial probability. Conditional probability and independence. Bayes theorem and its applications. Random variables and expectations. Moments and moment generating functions. Cumulants and Cumulant generating functions. Characteristic function. Standard univariate discrete and continuous distributions. Bivariate probability distributions. Marginal and Conditional distributions. Independence of variates. Bivariate normal and multivariate normal distributions. Transformation in univariate and bivariate distributions. Chebychev's inequality. Weak law of large numbers. Strong law of large numbers. Central limit theorem. Sampling distribution of a statistic, standard errors of sample mean and sample proportion. Sampling distribution of sample mean and sample variance for normal distribution. Sampling distributions of Chi-square, t- and F- statistics.

Descriptive Statistics: Measures of location and dispersion. Measures of skewness and kurtosis. Absolute moments and factorial moments. Inequalities concerning moments. Theory of attributes, consistency of data, conditions for consistency, independence and association of attributes, measures of association and contingency. Correlation and regression. Karl Pearson's

coefficient of correlation. Lines of regression. Rank correlation. Intraclass correlation. Multiple and partial correlations. Simple linear regression.

Statistical Inference: Elementary theory of estimation (consistency, unbiasedness, minimum variance, sufficiency). Minimum variance unbiased estimators. Cramer-Rao inequality. Methods of estimation (maximum likelihood method, method of moments). Rao-Blackwell and Lehmann-Scheffe theorems. Interval estimation (confidence intervals for the parameters of normal distribution, confidence intervals for difference of means and for ratio of variances). Tests of hypotheses (basic concepts, MP test and region, simple applications of Neyman-Pearson lemma, likelihood ratio test, UMP test, UMPU test). Non-parametric tests (sign-test, Wald-Wolfowitz run test, run test for randomness, median test, Wilcoxon-Mann-Whitney test).

Sample Surveys and Design of Experiments: Sampling and non-sampling errors. Conventional sampling techniques (SRSWR/SRSWOR, stratified random sampling, systematic sampling). Ratio and regression methods of estimation.

ANOVA and ANOCOVA. Basic designs such as CRD, RBD, LSD and their analyses. Missing plot technique. $2^n \left(n \leq 5\right)$ Factorial experiments and their construction and analysis. Total and partial confounding.