**Detailed Syllabus for Entrance Examination:**

**Real Analysis**

**Probability**

**Linear Algebra and Linear Programming**
Vectors and Matrices: Vector spaces and subspaces, Linear dependence and independence, span, basis, orthogonality and orthonormality. Matrix algebra; Linear programming: Graphical Solution and Simplex Algorithm

**Sampling Distributions**
Non-central x^2, t & F distributions – definitions and properties. Distribution of quadratic forms – Cochran’s theorem.

**Large Sample Theory**

**Statistical Inference**


**Linear Models**

Gauss Markov Model: Estimable function, error function, BLUE, Gauss Markov theorem. Correlated set-up, least squares estimate with restriction on parameters.

Linear Set, General linear hypothesis – related sampling distributions, Multiple comparison techniques due to Scheffe and Tukey.


Regression analysis, Analysis of covariance.

**Regression Analysis**

Building a regression model: Transformations – Box-Cox model, Stepwise regression, Model selection (adjusted $R^2$, cross validation and Mallow's Cp criteria, AIC and BIC), Multicollinearity.

Detection of outliers and influential observations: residuals and leverages, DFBETA, DFFIT and Cook’s Distance.

Checking for normality: Q-Q plots, Normal Probability plot, Shapiro-Wilks test.

Departures from the Gauss-Markov set-up: Heteroscedasticity and Autocorrelation – detection and remedies.


Binary data and Count data: ungrouped and grouped. Polytomous data.

Over dispersion, Quasi-likelihood.

Models with constant coefficient of variation, joint modeling of mean and variance, Generalized additive models.

Discrete longitudinal data - generalized linear marginal models, GEE for marginal models, Generalized linear subject specific models and transition models.

Design of Experiments

Block Designs: Connectedness, Orthogonality, Balance and Efficiency; Resolvable designs; Properties of BIB designs, Designs derived from BIB designs.

Intrablock analysis of BIB, Lattice and PBIB designs, Row column designs, Youden Square designs; Recovery of inter-block information in BIB designs; Missing plot technique.

Construction of mutually orthogonal Latin Squares (MOLS); Construction of BIB designs through MOLS and Bose’s fundamental method of differences.

Factorial designs: Analysis, Confounding and balancing in Symmetric Factorials.

Sample Surveys

Bayesian Analysis
Different Priors and related Posteriors
Estimation, testing and prediction for Univariate Normal distribution with known / unknown mean and / or variance.
Hierarchical and Empirical Bayes under normal setup.
Prior and posterior analysis in Generalized linear models

Decision Theory
Risk function, Admissibility of decision rules, Complete, essentially complete, minimal complete and minimal essentially complete classes. Essential completeness and completeness of class of rules based on sufficient statistic and the class of nonrandomized rules for convex loss

Resampling Techniques
Empirical distribution function and its properties
Jackknife and Bootstrap for estimating bias and standard error.
Consistency of the Jackknife variance estimate in an iid setup.
Bootstrap confidence intervals.

Stochastic Processes

Poisson process. Renewal Theory: renewal processes, renewal function, elementary renewal theorem, applications, Blackwell's theorem and key renewal theorem (statements), applications, alternating renewal processes, applications to limiting excess and age.


Time Series Analysis
Box-Jenkins Models – identification, estimation and diagnostic checking.
Volatility – ARCH, GARCH models.

Multivariate Analysis:
Multivariate normal distribution and its properties- marginal and conditional distributions. Random sampling from a multivariate normal distribution- UMVUE and MLE of parameters, joint distribution of sample mean vector and SS-SP matrix; Wishart distribution and its properties. Distribution of sample correlation coefficients, partial and multiple correlation coefficients partial regression coefficient and intraclass correlation coefficient. Distributions of Hotelling’s Tand Mahalanobis’ Dstatistics- their applications in testing and confidence set construction. Multivariate linear model, MANOVA for one-way and two-way classified data.

Applied Multivariate Analysis
Clustering: Hierarchical clustering for continuous and categorical data- different choices of proximity measures, Agglomerative and Divisive algorithms.
K-means clustering- optimum choice of the number of clusters.
**Principal Component Analysis**: Population and sample Principal components and their uses. Plotting techniques, Large sample inferences.

**Factor Analysis**: The orthogonal factor model, Estimation of factor loading, Factor rotation, Estimation of Factor scores, Interpretation of Factor Analysis.

**Canonical Correlations**: Population and sample canonical variables and canonical correlations and their interpretations. Plotting techniques, Large sample inferences.