Syllabus for Ph.D Entrance-Test

UNIT- 01 PROBABILITY AND DISTRIBUTION THEORY

Standard Univariate discrete distributions: Discrete Uniform, Bernoulli, Binomial, Poisson, Negative Binomial, Geometric, Hyper geometric, Logarithmic series distribution, Power series and generalized power series distributions andtheir structural properties and applications. Univariate Continuous distributions: Uniform, Beta, Gamma, Exponential, Pareto, Weibull, Laplace, Normal, Cauchy, Logistic and Lognormal distributions and their structural properties and applications. Modes of convergence, weak and strong laws of large numbers, central limit theorem (i.i.d case) Order Statistics: Distribution and properties. Joint and marginal distributions of order statistics. Distribution of median and range. Sampling distributions. Chi-square, t and F distributions and their properties and applications, Non-central t, F and Chi-square distribution. Test of significance of Normal, t, F and Chi-square.

UNIT- 02 SAMPLING THEORY

Simple Random Sampling, expected value and sampling variance of the sample mean, expected value of the sample mean square and estimation of the variance. Stratified random Sampling: Estimation of the population mean/total and itsvariance, choice of sample sizes in different strata, variance under different allocations. Comparison with unstratified sampling. Estimation of the gain in precision due to stratification, construction of strata. Ratio and Regression methods of Estimation: Variance of the estimates, estimation of variances, optimum property of ratio and regression estimator. Ratio and regression estimator in stratified random sampling. Some modifications of ratio and regression estimators. Comparison among regression, ratio and simple unbiased estimates. Unbiased ratio type estimates. Systematic Sampling: Sample mean and its variances. Comparison ofsystematic with simple random and stratified sampling in the general case and alsoin the case of linear trend.

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(Prof. & Head)	(Professor)	(Associate Professor)	(Associate Professor)

UNIT- 03 LINEAR MODELS & DESIGN OF EXPERIMENTS

Gauss Markov set up, Model classification, Normal equations and least squares estimates, Error and estimation space, Variance and covariance of least square estimates, Estimation of error variance, estimation with correlated observations, least square estimates with restriction on parameters. Test of hypotheses for one and more than one linear parametric functions, Tests of linear hypotheses, estimable linear hypotheses. Fixed, random and mixed effect model, simple and multiple regressions. Design of experiments: Introduction to basic designs and their analysis, Balance Incomplete Block Design. Intra block analysis, Inter block analysis, recovery of inter block information; General factorial experiments, factorial effects; best estimates and testing the significance of factorial effects; study of 2 and 3 factorial experiments in randomized blocks; complete and partial confounding.

UNIT- 04 STATISTICAL INFERENCE

Point Estimation: The general statistical decision problem, Criteria of unbiasedness, consistency and efficiency. Cramer-Rao Inequality. Minimum variance unbiased (MVU) estimation, Bhattacharya bound, Chapman Robin's Inequality. Sufficient and Complete Statistics: Sufficiency, Minimal sufficient statistic, Factorization theorem, Fisher– Neyman criterion. Rao-Blackwell theorem. Completeness and Lehman –Scheffler theorem. Methods of estimation: Method of maximum likelihood (MLE), Moments, Minimum Chi – square, modified minimum Chi –square and least square estimate. Bayesian Inference: Bayesian Point estimation, Interval Estimation: Determination of confidence interval based on small and large samples. Bayesian interval estimation. Testing of Hypothesis: Most Powerful (MP) and Uniformly most powerful (UMP) test, in class of size tests. Nyman Pearson Lemma, MP tests for simple null against simple alternative hypothesis. None Parametric Inference: Introduction, Advantages of none parametric methods over parametric methods. One Sample Problem: Sign Test, Wilcoxon-Signed rank test, Kolmogorov Smirnov Test, ARE, Applications of Pitman's theorem on the calculation of efficiency and ARE for Sign Test.

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UNIT-05: MULTIVARIATE ANALYSIS

Multivariate Normal Distribution Theory: Marginal and conditional distribution, Joint distribution, Linear function of correlated normal variate. Characteristics function of multivariate normal distribution, Maximum likelihood estimation ofthe mean vector and co-variance matrix and their independence. Distribution of sample mean vector. Large sample behavior of mean vector and co-variance matrix. Distribution of non-central chi-square, Quadratic form and its distribution. Multiple and partial correlation co-efficient and their sampling distribution. Simple regression model, regression co-efficient and distribution of sample regression co-efficient. Test of linear hypothesis about regression co- efficient and interval estimation. Canonical Correlation and the distribution of canonical Correlation. Distribution of sample co-variance matrix and the sample generalized variance; Wishart matrix and its distribution. Some important properties of the Wishart distribution. Characteristic function of Wishart distribution. Generalized T^2 statistics: The general T^2statistics, Derivation of the generalized T^2 statistics and its distribution. Some important properties of T^2 statistics and its uses. Walk's lambda criterion and its distribution. Mahalanobis D^2 statistics and its distribution. Classification and discrimination: Classification anddiscrimination procedure for discrimination between two multivariate normal populations. Sample discriminant function, classification into two and more than two multivariate normal population. Principal Component: Definition of principal components, uses, estimation and computation, Statistical inference on principal components.

UNIT- 06 INDUSTRIAL STATISTICS & RELIABILITY THEORY

Consumer and producer's risk, Operating Characteristic curve/function (OC). Corrective Sampling Plan (CSP), Average Sample Number (ASN), Average out- going Quality (AOQ), Graphical method of drawing AOQ, Average out-going Quality Limit (AOQL), Single Sampling Plan, Methods of finding n and c, Double

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Sampling Inspection Plan, Sequential Sampling Plan. Plans for Inspection by Variables for one-sided specification. Sequential Analysis: Definition of Sequential Probability Ratio Test (SPRT). Fundamental relations among α, β, A and B. Reliability concepts, hazard rate, distribution of longevity and moments, common life distributions, exponential, Weibull, normal distributions. Type I and Type II censored samples with replacement. Reliability of a system with independentunits connected in (a) series and (b) Parallel systems.

UNIT- 07 OPERATIONS RESEARCH

Simplex method, Revised Simplex Method, Transportation, duality theorems, Complementary Slackness theorem and conditions, Dual Simplex Method, Sensitivity Analysis. Sequencing and scheduling problems, 3 machine n-job problems with identical machine sequence for all jobs; 2-job n-machine problem with different routings. Project management; PERT and CPM. Decision Making in the face of competition, two–person, Zero sum games, Games with mixed strategies, existence of solution and uniqueness of value in zero-sum games, finding solutions in mxn games, Equivalence between game theory and linearprogramming problem. Multistage decision processes and Dynamic Programming, Multi Criterion and Goal Programming. EOQ problem with and without shortages with (a) production is instantaneous, Dynamic Programming. Queuing models- specifications and effectiveness measures. Steady-state solutions M/M/1 and M/M/c models with associated distributions of queue-length and waiting time.M/G/1 queue. Steady-state solutions of M/Ek/1.Nonlinear programming, Formulation, Lagrange multiplier Technique, Kuhn-Tucker necessary and sufficient conditions for optimality of an NLPP, Quadratic Programming problems, Wolfe's and Beal's algorithms for solving quadratic programming problems.

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