

**KLE Society's  
Raja Lakhamagouda Science Institute (Autonomous), Belagavi  
DEPARTMENT OF STATISTICS  
V – SEMESTER**

**Sampling Techniques  
COURSE TYPE: DSE**

**COURSE CODE: 20ST501**

**Credits: 04**

**Course outcomes:**

**CO1:** Practical sampling provides guidance for researchers dealing with the everyday problems of sampling.

**CO2:** Practical sample design seeks to produce valid and credible sample data and statistics that match the precision needed for the study.

**CO3:** Practical sample design is an approach that integrates sampling design and execution into the overall research process using the concept of total error for the assessment.

**Unit 1. Introduction to Sampling Theory: (10 hrs)**

Concepts of population and sample, need for sampling, complete enumeration and sample surveys, non-probability and probability sampling: meaning, need and illustration, use of random numbers, principal steps in a sample survey, principles of sampling, requisites of a good questionnaire, pilot surveys, sampling and non-sampling errors.

**Unit 2: Simple Random Sampling: (12 hrs)**

Sampling with and without replacements, unbiased estimators of population mean and total, derivation of sampling variance, standard errors of the estimators. Determination of sample size, formulae for sample size in sampling for proportions and means.

**Unit 3: Stratified Random Sampling: (10 hrs)**

Need for stratification, unbiased estimator of mean and total in stratified random sampling, derivation of the SE's and their estimation, allocation of sample size under proportional and optimum (Neyman) allocation, comparison of  $\text{Var}(\text{ran})$ ,  $\text{Var}(\text{prop})$  and  $\text{Var}(\text{opt})$ , estimation of gain in precision due to stratification (without proof).

**Unit 4: Systematic Sampling: (10 hrs)**

Unbiased estimator of population size mean and its variance, expression of variance with intra class correlation, systematic sampling with linear trend, comparison of systematic sampling with sample and stratified random sampling procedure.

**Unit 5: Cluster Sampling: (8 hrs)**

Equal size cluster sampling, Estimation of population mean and total and their standard errors, comparison of cluster sampling with SRS in terms of intra class correlation coefficient.

**Books for Reference:**

1. D. Singh and Chaudhary. F. S., 2018, Theory and Analysis of Sample survey design, New Age International, Mumbai.
2. Gupta. S.C and Kapoor. V. K. 2014, Fundamentals of Applied Statistics, Sultan Chand publications.
3. Parimal Mukhopadhyay, 2008, Theory and Methods of Survey Sampling, Prentice HallIndia.
4. S. Sampath, 2001, Sampling Theory and Methods, Narosa Publishing House, New Delhi. 5. P. V. Sukhatme, 1957, Sampling Theory of Surveys with Application, The Bangalore Press, Bangalore.

**Skill Enhancement Course  
Title: Operation Research – I**

**COURSE TYPE: SEC**

**COURSE CODE: 20ST511****Credits: 02****Course outcomes:****CO1:** To apply various sampling method for different types of data.**CO2:** To explain and to compare various allocations using stratified random sampling.**CO3:** To draw a conclusion about the best sampling procedure.**CO4:** To use practical applications of ratio and regression method of estimation.**Unit 1: Introduction and Linear Programming Problem (LPP) (13 hrs)**

Meaning, origin, development, and scope, phases and models of operations research. Basic concepts and formulation of an LPP standard and canonical form, slack and surplus variable, graphical solution, types of solutions –basic solution, feasible solution, basic feasible solution, optimal solution and degenerate solution

**Unit 2: Simple Method (12 hrs)**

Basic definitions, Big-M method and examples, primal and dual relationship with examples

**Reference Books:**

1. Dr. D. S. Hira, 2014, Operations Research, S. Chand, New Delhi.
2. P. Rama Murthy, 2017, Operations Research, New Age International.
3. Man Mohan P. K. and Gupta Kanti Swarup, 1978, Operations Research, S. Chand, New Delhi.
4. Hamdy A. Taha, 2017, Operations Research an Introduction, Pearson

**DEPARTMENT OF STATISTICS**  
**V – SEMESTER**  
**Statistical Practical-V**  
**COURSE TYPE: DSE**

**COURSE CODE: 20ST502**

**Credits: 02**

**Course outcomes:**

**CO1:** To apply various sampling method for different types of data.

**CO2:** To draw a conclusion about the best sampling procedure.

**CO3:** To apply various sampling methods for agricultural data

**CO4:** To draw a conclusion about the best sampling procedure.

**CO5:** To explain and to compare various allocations using stratified random sampling.

**CO6:** Understand the principles underlying sampling as a means of making inferences about a population.

Pract.1 Basic Problems on sampling I

Pract.2 Basic Problems on sampling II

Pract.3 Simple Random sampling I

Pract.4 Simple Random Sampling II

Pract.5 Stratified Random sampling I

Pract.6 Stratified Random sampling II

Pract.7 Systematic Sampling I

Pract.8 Systematic Sampling II

Pract.9 Cluster Sampling I

Pract.10 Cluster Sampling II

**DEPARTMENT OF STATISTICS**  
**V – SEMESTER**  
**Statistical Practical-VI**  
**COURSE TYPE: DSE**

**COURSE CODE: 20ST503**

**Credits: 02**

**Course outcomes:**

**CO1:** Identify and develop operational research models from the verbal description of the real system.

**CO2:** Understand the mathematical tools that are needed to solve optimization problems.

**CO3:** Use mathematical software to solve the proposed models. Develop a report that describes the model and the solving technique, analyze the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.

**CO4:** Understand the concept of optimization problem, theory of duality.

Pract.1 Introduction to OR

Pract.2 Linear Programming Problem I

Pract.3 Linear Programming Problem II

Pract.4 Linear Programming Problem III

Pract.5 Simplex method I

Pract.6 Simplex method II

Pract.7 Simplex method III

Pract.8 Game Theory I

Pract.9 Game Theory II

Pract.10 Game Theory III

**KLE Society's  
Raja Lakhamagouda Science Institute (Autonomous), Belagavi  
DEPARTMENT OF STATISTICS  
VI SEMESTER**

**Title: Design of Experiments and SQC**

**COURSE TYPE: DSE**

**COURSE CODE: 20ST601**

**Credits: 04**

**Course out comes:**

**CO1:** To Calculate and interpret the degrees of freedom, between-group variance (MSBG), withingroup variance, and the F-ratio for the one-way ANOVA.

**CO2:** Get the knowledge about How to design and conduct experiments, and how to analyze them properly to answer various research questions.

**CO3:** Get the knowledge about how a factorial design can be used to build on previous research, control for threats to validity, and enhance the informativeness of interpretation. **CO4:** To understand the philosophy and basic concepts of quality improvement.

**CO5:** Design, use, and interpret exponentially weighted moving average and moving average control charts.

**Unit 1: Analysis of Variance: (8hrs)**

Meaning and assumptions, analysis of variance (fixed effects model)-analysis one way, two way classified data-expectation of mean sum of squares, ANOVA tables, case of multiple with equal number of observations per cell in two way classification with interaction.

**Unit 2: Design of Experiments: (14hrs)**

Principles of randomization, replication and local control, completely randomized design, randomized block design and Latin square designs-layout, model, least squares estimates of parameters, hypothesis, test procedure and ANOVA tables, efficiency of design, missing value technique for RBD and LSD-estimation of single missing observation.

**Unit 3: Factorial Experiments: (8hrs)**

Introduction, 22 factorial designs, 23 factorial design, 2nd factorial design, confounding in factorial designs, Yates correction.

**Unit 4: Statistical Quality Control I: (8hrs)**

Introduction, Basics of statistical quality control, definition, Benefits of SQC, Process control and Product control, Control charts- major parts of control charts, 3 sigma control limits.

**Unit 5: Statistical Quality Control II: (12 hrs)**

Control charts for variables-Mean and Range, Control charts for standard deviation. Control charts for attributes- Construction of p-charts, d – charts, c- chart, application of c-chart with illustrations.

**Books for Reference:**

1. Rohatgi. V.K., 1984, An introduction to probability theory and Mathematical statistics, Wiley.
2. Gupta. S.C and Kapoor. V. K. (2014), Fundamentals of Applied Statistics, Sultan Chand publications.
3. D. C. Montgomery, 2019, Introduction to Statistical Quality Control, Willey.
4. D. C. Montgomery, 2012, Design and Analysis of Experiments, Willey.
5. Statistical Quality Control by M. Jeya Chandra, 2001.

**STATISTICS  
VI SEMESTER  
Skill Enhancement Course  
Title: Operation Research – II  
COURSE TYPE: SEC**

**COURSE CODE: 20ST611****Credits: 02****Course out comes:**

**CO1:** Understand basic concepts of inventory problems and solve various types of EOQ models.

**CO2:** Understand basic concepts of replacement problems solve without considering and with considering change in money value and group replacement.

**CO3:** Understand the concept of simulation technique by Monte Carlo and Boxmullar transformation.

**CO4:** Understand the concept of economic data and inference.

**Unit 1: Game Theory: (10 hrs)**

Introduction, basic definitions, characteristics of the game, 2-person zero sum game, pure and mixed strategies, solution of games with saddle point, without saddle point, maximin and minimax principle and dominance principle, solution by graphical method (2xn and m x 2) games.

**Unit 2: Transportation Problem: (15 hrs)**

Definition, TP is a particular case of LPP, mathematical formulation, Initial solution by North-West corner method, Matrix minima method, Vogel's approximation method and MODI method for optimality test- with balanced Assignment Problem: Introduction, mathematical formulation, assignment problems by Hungarian method and examples with balanced and unbalanced AP.

**Reference Books:**

1. Dr. D. S. Hira, 2014, Operations Research, S. Chand, New Delhi.
2. P. Rama Murthy, 2017, Operations Research, New Age International.

3. Man Mohan P. K. and Gupta Kanti Swarup, 1978, Operations Research, S. Chand, New Delhi.
4. Hamdy A. Taha, 2017, Operations Research an Introduction, Pearson

**STATISTICS**  
**VI SEMESTER**  
**Statistical Practical-VII**  
**COURSE TYPE: DSE**

**COURSE CODE: 20ST602**

**Credits: 02**

**Course outcomes:**

CO1: Able to set, analysis and interpret the hypothesis for means, proportions and variance.

CO2: Understand to define the problem and plan experiment.

CO3: To able to understand how to select factors and levels.

CO4: To define the number of experiments to conduct.

CO5: Can be able to set hypothesis for the experiment and also to determine the test statistics.

CO6: To determine the type of experiment can select the appropriate experiment method.

CO7: To be able to check the model adequacy and interpret the experimental results with MINITAB software and interpret them.

Pract.1 One Way Analysis of Variance.

Pract.2 Two Way Analysis of Variance.

Pract.3 Completely randomized design.

Pract.4 Randomized block design.

Pract.5 Latin square designs.

Pract.6 Missing value technique for RBD and LSD.

Pract.7 Factorial Experiments I.

Pract.8 Factorial Experiments II.

Pract. 9 Statistical Quality Control-I.

Pract. 10 Statistical Quality Control-II



**STATISTICS**  
**VI SEMESTER**  
**Statistical Practical-VIII**  
**COURSE TYPE: DSE**

**COURSE CODE: 20ST603**

**Credits: 02**

**Course out comes:**

**CO1:** Understand basic concepts of inventory problems and solve various types of EOQ models.

**CO2:** Understand basic concepts of replacement problems solve without considering and with considering change in money value and group replacement.

**CO3:** Understand the concept of simulation technique by MonteCarloand Box Mullar transformation.

**CO4:** Understand the concept of economic data and inference.

**CO5:** Understand basic concepts of game theory and methods of solving game problems.  
Pract.1 Game Theory I (Minimax Maxmini Principle).

Pract.2 Game Theory II (Dominance Property).

Pract.3 Game Theory III (Graphical Method).

Pract.4 Transportation Problem I.

Pract.5 Transportation Problem II.

Pract.6 Transportation Problem III.

Pract.7 Assignment Problem I.

Pract.8 Assignment Problem II.

Pract.9 Assignment Problem III.

