

S. P. Mandali's
Ramnarain Ruia Autonomous College
(Affiliated to University of Mumbai)



Syllabus for

Program: S.Y.B.Sc.

Program Code: (STATISTICS) RUSSTA

(Choice Based Credit System for the
academic year 2023–2024)

GRADUATE ATTRIBUTES

S. P. Mandali's Ramnarain Ruia Autonomous College has adopted the Outcome Based Education model to make its science graduates globally competent and capable of advancing in their careers. The Bachelors Program in Science also encourages students to reflect on the broader purpose of their education.

| GA | GA Description |
|-----------|---|
| | A student completing Bachelor's Degree in Science program will be able to: |
| GA 1 | Recall and explain acquired scientific knowledge in a comprehensive manner and apply the skills acquired in their chosen discipline. Interpret scientific ideas and relate its interconnectedness to various fields in science. |
| GA 2 | Evaluate scientific ideas critically, analyse problems, explore options for practical demonstrations, illustrate work plans and execute them, organise data and draw inferences. |
| GA 3 | Explore and evaluate digital information and use it for knowledge upgradation. Apply relevant information so gathered for analysis and communication using appropriate digital tools. |
| GA 4 | Ask relevant questions, understand scientific relevance, hypothesize a scientific problem, construct and execute a project plan and analyse results. |
| GA 5 | Take complex challenges, work responsibly and independently, as well as in cohesion with a team for completion of a task. Communicate effectively, convincingly and in an articulate manner. |
| GA 6 | Apply scientific information with sensitivity to values of different cultural groups. Disseminate scientific knowledge effectively for upliftment of the society. |
| GA 7 | Follow ethical practices at work place and be unbiased and critical in interpretation of scientific data. Understand the environmental issues and explore sustainable solutions for it. |
| GA 8 | Keep abreast with current scientific developments in the specific discipline and adapt to technological advancements for better application of scientific knowledge as a lifelong learner. |

PROGRAM OUTCOMES

| PO | Description |
|-------------|---|
| | A student completing Bachelor's Degree in Science program in the subject of Statistics will be able to: |
| PO 1 | Understand, condense, visualize, analyze and interpret various data types generated in various scenarios of scientific, industrial, or social problems. |
| PO 2 | Apply Statistical tools for data analysis. |
| PO 3 | Pursue their higher education programs leading to post-graduate and/or doctoral degrees in Statistics, Data Science, Business Analytics, Biostatistics, Econometrics, Management Studies. |
| PO 4 | Compete globally to enter into promising careers. |
| PO 5 | Make a pathway to a range of traditional avenues in Academia and Industry, Govt. Service, IAS, Indian Statistical/ Economic Services, Industries, Commerce, Investment Banking, Banks and Insurance Sectors, CSO and NSSO, Research Personnel/Investigator in Govt. organizations such as NCAER, IAMR, ICMR, Statistical and Economic Bureau & various PSUs., Market Research, Actuarial Sciences, Biostatistics, Demography etc. |
| PO 6 | Seek employment or self-employment in different sectors like Stock trading, Pharmaceutical sector, Sports, Politics, Business, Financial services and Media Industry. |

PROGRAM OUTLINE

| YEAR | SEM | COURSE CODE | COURSE TITLE | CREDITS |
|-------|-----|-------------|---|---------|
| SYBSc | III | RUSSTA301 | PROBABILITY DISTRIBUTIONS | 2 |
| SYBSc | III | RUSSTA302 | THEORY OF SAMPLING | 2 |
| SYBSc | III | RUSSTA303 | OPERATIONS RESEARCH | 2 |
| SYBSc | III | RUSSTAP301 | Practical based on RUSSTA301, RUSSTA302 & RUSSTA303 | 3 |
| SYBSc | IV | RUSSTA401 | PROBABILITY AND SAMPLING DISTRIBUTIONS | 2 |
| SYBSc | IV | RUSSTA402 | ANALYSIS OF VARIANCE & DESIGN OF EXPERIMENTS | 2 |
| SYBSc | IV | RUSSTA403 | PROJECT MANAGEMENT AND INDUSTRIAL STATISTICS | 2 |
| SYBSc | IV | RUSSTAP401 | Practical based on RUSSTA401, RUSSTA402 and RUSSTA403 | 3 |

Course Code: RUSSTA301

Course Title: PROBABILITY DISTRIBUTIONS

Academic year 2023-24

COURSE OUTCOMES:

| COURSE OUTCOME | DESCRIPTION |
|----------------|--|
| | At the end of this course students will be able to |
| CO 1 | Identify various Standard Discrete Probability Distributions and their use. |
| CO 2 | Distinguish between different types of Standard Discrete Probability Distributions and prove their properties and apply those for problem solving. |
| CO 3 | Recognize the underlying distribution in different situations. |

DETAILED SYLLABUS

| Course Code/ Unit | Unit | Course/ Unit Title | Credits/ Lectures |
|-------------------|----------|---|-------------------|
| RUSSTA301 | Unit I | Univariate Random Variables (Discrete and Continuous): <ul style="list-style-type: none"> • Moment Generating Function, Cumulant generating Function-Their important properties. Relationship between moments and cumulants and their uses. • Characteristic Function- Its properties (without proof). • Transformation of random Variable | 15 Lectures |
| RUSSTA301 | Unit II | Standard Discrete Probability Distributions: <ul style="list-style-type: none"> • Uniform, Bernoulli, Binomial, Poisson, Geometric, Negative Binomial & Hypergeometric distributions. • The following aspects of the above distributions (wherever applicable) to be discussed: • Mean, Mode and Standard deviation. Moment Generating Function, Cumulant • Generating Function, Additive property, Recurrence relation for central Moments, Skewness and Kurtosis (without proof), Limiting distribution. | 15 Lectures |
| RUSSTA301 | Unit III | Bivariate Probability Distributions: <ul style="list-style-type: none"> • Joint Probability mass function for Discrete random variables, Joint Probability density function for continuous random variables. Their properties. • Marginal and conditional Distributions. Independence of Random Variables. Conditional Expectation & Variance. • Regression Function. Coefficient of Correlation. Transformation of Random Variables and Jacobian of transformation with illustrations. | 15 Lectures |



Distribution of topics for Practical

| Course Code RUSSTAP301(A) | |
|----------------------------------|--|
| Sr. No. | Practical based on course |
| 1 | Moment Generating Function, Moments. |
| 2 | Cumulant generating Function, Cumulants, Characteristic function. |
| 3 | Standard Discrete Distributions |
| 4 | Fitting Standard Discrete Distributions. |
| 5 | Bivariate Probability Distributions, Marginal & Conditional distributions, Conditional Mean, Conditional Variance, Correlation |
| 6 | Transformation of discrete & continuous random variables. |

REFERENCES:

1. A. M. Mood, F.A. Graybill, D. C. Boyes, Third Edition; McGraw-Hill Book Company. Introduction to the theory of statistics
2. R.V. Hogg, A.T. Craig; Fourth Edition; Collier McMillan Publishers: Introduction to Mathematical Statistics
3. R.V. Hogg, E. A. Tannis, Third Edition; Collier McMillan Publishers: Probability and Statistical Inference
4. I. Miller, M. Miller; Sixth Edition; Pearson Education Inc.: John E. Freund's Mathematical Statistics
5. P.G. Hoel; Fourth Edition; John Wiley & Sons Inc.: Introduction to Mathematical Statistics
6. S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons.: Fundamentals of Mathematical Statistics
7. J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.: Mathematical Statistics
8. J. Medhi; Second edition; Wiley Eastern Ltd.: Statistical Methods: An Introductory Text
9. A.M. Goon, M.K. Gupta, B. DasGupta; Third Edition; The World Press Pvt. Ltd.: An Outline of Statistical Theory Vol. 1

Course Code: RUSSTA302

Course Title: THEORY OF SAMPLING



Academic year 2023-24

COURSE OUTCOMES:

| COURSE OUTCOME | DESCRIPTION A student completing this course will be able to: |
|----------------|--|
| CO 1 | Understand the importance and use of sampling and its various methods. |
| CO 2 | Calculate population parameters using Simple Random Sampling, Stratified Sampling, and Systematic Sampling techniques. |
| CO 3 | Differentiate between types of probability sampling methods. |
| CO 4 | Apply Ratio and Regression methods of estimation to incorporate auxiliary information into surveys. |

DETAILED SYLLABUS

| Course Code/ Unit | Unit | Course/ Unit Title | Credits/ Lectures |
|-------------------|------|--------------------|-------------------|
|-------------------|------|--------------------|-------------------|

| | | | |
|-----------|-------------|--|----------------|
| RUSSTA302 | Unit I | Concepts: <ul style="list-style-type: none"> Population, Population unit, Sample, Sample unit, Parameter, Statistic, Estimator, Bias, Unbiasedness, Mean square error & Standard error. Census survey, Sample Survey. Steps in conducting a sample survey. Concepts of Sampling and Non-sampling errors. Concepts and methods of Probability and Non-Probability sampling. Simple Random Sampling (SRS): <ul style="list-style-type: none"> Description of Simple Random Sampling with & without replacement. Lottery method & use of Random numbers to select Simple random sample. Estimation of population mean & total. Expectation & Variance of the estimators, Unbiased estimator of variance of these estimators. Estimation of population proportion. Expectation & Variance of the estimators, Unbiased estimator of variance of these estimators. Estimation of Sample size based on a desired accuracy in case of SRS for variables & attributes. | 15 Lectures |
| RUSSTA302 | Unit II | Stratified Sampling: <ul style="list-style-type: none"> Need for Stratification of population with suitable examples. Description of Stratified Random Sample. Advantages of stratified random Sampling. Stratified Random Sampling: <ul style="list-style-type: none"> Estimation of population mean & total in case of Stratified Random Sampling (WOR within each stratum). Expectation & Variance of the unbiased estimators, Unbiased estimators of variances of these estimators. Equal Allocation, Proportional allocation, Optimum allocation with and without varying costs. Comparison of Simple Random Sampling, Stratified Random Sampling using Proportional allocation & Neyman allocation | 15 Lectures |
| RUSSTA302 | Unit III | Ratio & Regression Estimation assuming SRSWOR: <ul style="list-style-type: none"> Ratio Estimators for population Ratio, Mean & | 15 Lectures |



| | | | |
|--|--|---|--|
| | | <p>Total. Expectation & MSE of the Estimators. Estimators of MSE. Uses of Ratio Estimator.</p> <ul style="list-style-type: none"> • Regression Estimators for population Mean & Total. Expectation & Variance of the Estimators assuming known value of regression coefficient 'b'. • Estimation of 'b'. Resulting variance of the estimators. Uses of regression estimator. • Comparison of Ratio, Regression & mean per Unit estimators. <p>Systematic sampling:</p> <ul style="list-style-type: none"> • Estimator of Population Mean and its Variance. Comparison of Systematic Sampling with Simple Random sampling • Introduction to Cluster sampling & Two Stage sampling with suitable illustrations. | |
|--|--|---|--|

Distribution of topics for Practical

| Course Code RUSSTAP301(B) | |
|---------------------------|--|
| Sr. No. | Practical based on course |
| 1 | Designing of Questionnaire. |
| 2 | Simple Random Sampling for Variables. |
| 3 | Simple Random Sampling for Attributes. |
| 4 | Estimation of Sample Size in Simple Random Sampling. |
| 5 | Stratified Random Sampling. |
| 6 | Ratio Estimation- Regression Estimation. |
| 7 | Systematic Sampling |

REFERENCES:

1. W.G. Cochran; 3rd Edition; Wiley (1978): Sampling Techniques
2. M. N. Murthy; Statistical Publishing Society. (1967): Sampling Theory and methods
3. Des Raj; McGraw Hill Series in Probability and Statistics. (1968): Sampling Theory



4. P.V. Sukhatme and B.V. Sukhatme; 3rd Edition; Iowa State University Press (1984): Sampling Theory of Surveys with Applications
5. S. C. Gupta and V.K. Kapoor; 3rd Edition; Sultan Chand and Sons (2001): Fundamentals of Applied Statistics
6. Daroga Singh, F.S.Chaudhary, Wiley Eastern Ltd. (1986): Theory and Analysis of Sample Survey Designs:
7. S. Sampath, Second Edition (2005), Narosa: Sampling Theory and Methods
8. Parimal Mukhopadhyay, (1998), Prentice Hall Of India Pvt. Ltd.: Theory and Methods of Survey Sampling

Course Code: RUSSTA303

Course Title: OPERATIONS RESEARCH

Academic year 2023-24

COURSE OUTCOMES:

| COURSE OUTCOME | DESCRIPTION |
|-----------------------|---|
| | A student completing this course will be able to: |
| CO 1 | Formulate and solve the linear programming problems through graphical methods and the simplex method. |
| CO 2 | Optimize transportation problems, assignment problems, and their variations. |
| CO 3 | Establish and correlate the primal and dual forms of a given linear programming problem. |
| CO 4 | Solve process sequencing problems utilizing Johnson's Method. |

DETAILED SYLLABUS

| Course Code/ Unit | Unit | Course/ Unit Title | Credits/ Lectures |
|--------------------------|---------------|--|--------------------------|
| RUSSTA303 | Unit I | Linear Programming Problem (L.P.P.): <ul style="list-style-type: none"> • Mathematical Formulation: Maximization & Minimization. Concepts of Solution, Feasible | 15 Lectures |



| | | | |
|------------------|-----------------|---|--------------------|
| | | <p>Solution, Basic Feasible Solution, Optimal solution.</p> <ul style="list-style-type: none"> Graphical Solution for problems with two variables. Simplex method of solving problems with two or more variables. Big M method. Concept of Duality. Its use in solving L.P.P. Relationship between optimum solutions to Primal and Dual. Economic interpretation of Dual. | |
| RUSSTA303 | Unit II | <p>Transportation Problem:</p> <ul style="list-style-type: none"> Concept, Mathematical Formulation. Concepts of Solution, Feasible Solution. Initial Basic Feasible Solution by North-West Corner Rule, Matrix Minima Method, Vogel's Approximation Method. Optimal Solution by MODI Method. Optimality test, Improvement procedure. Variants in Transportation Problem: Unbalanced, Maximization type, Restricted allocations. | 15 Lectures |
| RUSSTA303 | Unit III | <p>Assignment Problem:</p> <ul style="list-style-type: none"> Concept. Mathematical Formulation Solution by: Complete Enumeration Method and Hungarian method. Variants in Assignment Problem: Unbalanced, Maximization type. Airline Operating Problem Travelling Salesman Problem <p>Sequencing:</p> <ul style="list-style-type: none"> Processing n Jobs through 2 and 3 Machines, 2 Jobs through m Machines and n jobs through m machines | 15 Lectures |

Distribution of topics for Practical

| Course Code RUSSTAP301(C) | |
|----------------------------------|--|
| Sr. No. | Practical based on course |
| 1 | Formulation and Graphical Solution of L.P.P. |
| 2 | Simplex Method. |



| | |
|---|---|
| 3 | Duality. |
| 4 | Transportation. |
| 5 | Assignment. |
| 6 | Sequencing. |
| 7 | Problems solving using TORA / EXCEL Solver. |

REFERENCES:

1. Kantiswaroop and Manmohan Gupta. 4th Edition; S Chand & Sons: Operations Research
2. Richard Broson. 2nd edition Tata Mcgraw Hill Publishing Company Ltd.: Schaum Series book in O.R.
3. Methods and Problems: Maurice Sasieni, Arthur Yaspan and Lawrence Friedman, (1959), John Wiley & Sons: Operations Research
4. J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.: Mathematical Models in Operations Research
5. Harvey M. Wagner, 2nd Edition, Prentice Hall of India Ltd.: Principles of Operations Research with Applications to Management Decisions
6. S.D.Sharma.11th edition, Kedar Nath Ram Nath & Company.: Operations Research
7. H. A.Taha.6th edition, Prentice Hall of India.: Operations Research
8. J.K.Sharma, (2001), MacMillan India Ltd.: Quantitative Techniques For Managerial Decisions

Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

| Sr No | Evaluation type | Marks |
|-------|---|-----------|
| 1 | Class Test/ Project / Assignment / Presentation | 20 |
| 2 | Class Test/ Project / Assignment / Presentation | 20 |
| | TOTAL | 40 |

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:

Paper Pattern:

| Question | Options | Marks | Questions Based on |
|----------|--------------------------|-----------|--------------------|
| 1 | Any 2 out of 3 sub-parts | 20 | Unit I |
| 2 | Any 2 out of 3 sub-parts | 20 | Unit II |
| 3 | Any 2 out of 3 sub-parts | 20 | Unit III |
| | TOTAL | 60 | |

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

| Particulars | Marks |
|--|-----------|
| Journal and attendance | 5 |
| Assignments using Statistical Software | 15 |
| Total | 20 |

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:

Duration - These examinations shall be of **one and half hour** duration.

| Particulars | Paper |
|--|-----------|
| Exam (There shall be Three COMPULSORY Questions of 10 marks each with internal choice) | 30 |
| Total | 30 |

Overall Examination & Marks Distribution Pattern

Semester III

| Course | RUSSTA301 | | | RUSSTA302 | | | RUSSTA303 | | | Grand Total |
|--------|-----------|----------|-------|-----------|----------|-------|-----------|----------|-------|-------------|
| | Internal | External | Total | Internal | External | Total | Internal | External | Total | |
| | | | | | | | | | | |



| | | | | | | | | | | |
|------------|----|----|-----|----|----|-----|----|----|-----|-----|
| Theory | 40 | 60 | 100 | 40 | 60 | 100 | 40 | 60 | 100 | 300 |
| Practicals | 20 | 30 | 50 | 20 | 30 | 50 | 20 | 30 | 50 | 150 |

Course Code: RUSSTA401

Course Title: PROBABILITY AND SAMPLING DISTRIBUTIONS

Academic year 2023-24

COURSE OUTCOMES:

| COURSE OUTCOME | DESCRIPTION |
|----------------|--|
| | A student completing this course will be able to: |
| CO 1 | Know different types of Standard Continuous Probability Distributions and their importance. |
| CO 2 | Differentiate between various Standard Continuous Probability Distributions and use their properties for solving various problems. |
| CO 3 | Implement Exact Sampling distribution methods. |

DETAILED SYLLABUS

| Course Code/ Unit | Unit | Course/ Unit Title | Credits/ Lectures |
|-------------------|--------|---|-------------------|
| RUSSTA401 | Unit I | Standard Continuous Probability Distributions: <ul style="list-style-type: none"> Rectangular, Triangular, Exponential, Gamma (with Single & Double parameter), Beta (Type I & Type II). The following aspects of the above distributions (wherever applicable) to be discussed Mean, Median, Mode & Standard deviation. Moment Generating Function, Additive property, Cumulant Generating Function. Skewness and Kurtosis (without proof). Interrelation between the distributions. Normal Distribution: <ul style="list-style-type: none"> Mean, Median, Mode, Standard deviation, Moment Generating function, Cumulant Generating function, Moments & Cumulants (up to fourth order). Recurrence relation for central moments, skewness & kurtosis, Mean absolute deviation. Distribution of linear function of | 15 Lectures |

| | | | |
|-----------|----------|--|-------------|
| | | <p>independent Normal variables. Fitting of Normal Distribution.</p> <ul style="list-style-type: none"> Central Limit theorem for i.i.d. random variables. Log Normal Distribution: Derivation of mean & variance. | |
| RUSSTA401 | Unit II | <p>Chi-Square Distribution:</p> <ul style="list-style-type: none"> Concept of degrees of freedom. Mean, Median, Mode & Standard deviation. Moment generating function, Cumulant generating function. Additive property, Distribution of the sum of squares of independent Standard Normal variables. Sampling distributions of sample mean and sample variance and their independence for a sample drawn from Normal distribution (without proof). Applications of Chi-Square: Test of significance for specified value of variance of a Normal population. Test for goodness of fit & Test for independence of attributes (derivation of test statistics is not expected). | 15 Lectures |
| RUSSTA401 | Unit III | <p>t-distribution:</p> <ul style="list-style-type: none"> Mean, Median, Mode & Standard deviation. Derivation of t distribution using Fisher's t. Student's t. Asymptotic properties. Applications of t: Confidence interval for: Mean of Normal population, difference between means of two independent Normal populations having the same variance. Test of significance of: mean of a Normal population, difference in means of two Normal populations (based on: (i) independent samples with equal variances. (Effect Size, Cohen's d) (ii) dependent samples). F-distribution: Mean, Mode & Standard deviation. Distribution of: reciprocal of an F variate, Ratio of two independent Chi-squares divided by their respective degrees of freedom. Interrelationship of F with: t-distribution, Chi-square distribution & Normal distribution. Applications of F: Test for equality of variances of two independent Normal populations. | 15 Lectures |

Distribution of topics for Practical

| | |
|-----------------------------------|----------------------------------|
| Course Code: RUSSTAP401(A) | |
| Sr. No. | Practical based on course |



| | |
|---|------------------------------------|
| 1 | Standard Continuous distributions. |
| 2 | Normal Distribution |
| 3 | Central Limit Theorem |
| 4 | Chi Square distribution |
| 5 | t distribution |
| 6 | F distribution |
| 7 | Practical using Excel |

REFERENCES:

1. A M Mood, F.A. Graybill, D C Boyes; Third Edition; McGraw-Hill Book Company.: Introduction to the theory of statistics
2. R.V.Hogg, A.T. Craig; Fourth Edition; Collier McMillan Publishers.: Introduction to Mathematical Statistics
3. R.V.Hogg, E. A.Tannis, Third Edition; Collier McMillan Publishers.: Probability and Statistical Inference
4. I. Miller, M. Miller; Sixth Edition; Pearson Education Inc.: John E. Freund's Mathematical Statistics
5. P.G. Hoel; Fourth Edition; John Wiley & Sons Inc.: Introduction to Mathematical Statistics
6. S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons.: Fundamentals of Mathematical Statistics
7. J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.: Mathematical Statistics
8. J. Medhi; Second edition; Wiley Eastern Ltd.: Statistical Methods- An Introductory Text
9. A.M. Goon, M.K. Gupta, B. DasGupta; Third Edition; The World Press Pvt. Ltd.: An Outline of Statistical Theory Vol. 1

Course Code: RUSSTA402

Course Title: ANALYSIS OF VARIANCE & DESIGNS OF EXPERIMENTS

Academic year 2023-24

COURSE OUTCOMES:

| COURSE OUTCOME | DESCRIPTION |
|-----------------------|---|
| | A student completing this course will be able to: |
| CO 1 | Explain and illustrate the analysis of one-way and two-way classification. |
| CO 2 | Define key concepts in Experimental Design, outline the principles of experimental design, and enumerate various types of experimental designs. |
| CO 3 | Examine Completely Randomized Designs (CRD), Randomized Block Designs (RBD), and Least Significant Difference (LSD) using Analysis of Variance (ANOVA). |
| CO 4 | Create factorial experiments, analyze their results, and grasp the concept of confounding. |

DETAILED SYLLABUS

| Course Code/ Unit | Unit | Course/ Unit Title | Credits/ Lectures |
|--------------------------|----------------|--|--------------------------|
| RUSSTA402 | Unit I | Analysis of Variance: <ul style="list-style-type: none"> • Introduction, Uses, Cochran's Theorem (Statement only). • One-way classification with equal & unequal observations per class, • Two-way classification with one observation per cell. • For both the cases: Mathematical Model, Assumptions, Expectation of various sums of squares, F- test, Analysis of variance table. Least square estimators of the parameters, Expectation and Variance of the estimators, Estimation of linear contrasts, Standard Error and Confidence limits Testing for significance of elementary linear contrasts. | 15 Lectures |
| RUSSTA402 | Unit II | Design Of Experiments: <ul style="list-style-type: none"> • Concepts of Experiments, Experimental unit, Treatment, Yield, Block, Replicate, Experimental Error, Precision. • Principles of Design of Experiments: Replication, Randomization & Local Control. | 15 Lectures |



| | | | |
|-----------|----------|--|-------------|
| | | <ul style="list-style-type: none"> • Efficiency of design D_1 with respect to design D_2. • Choice of size, shape of plots & blocks in agricultural & non-agricultural experiments. <p>Completely Randomized Design (CRD) & Randomized Block Design (RBD):</p> <ul style="list-style-type: none"> • Mathematical Model, Assumptions, Expectation of various sums of squares, F-test, Analysis of variance table. • Least square estimators of the parameters, Variance of the estimators, Estimation of linear contrasts, Standard Error and Confidence limits Testing for significance of elementary linear contrasts. Efficiency of RBD relative to CRD. • Missing plot technique for one missing observation in case of CRD, RBD | |
| RUSSTA402 | Unit III | <p>Latin Square Design (LSD):</p> <ul style="list-style-type: none"> • Mathematical Model, Assumptions, Expectation of various sums of squares, F-test, Analysis of variance table. • Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard error and Confidence limits for elementary treatment contrasts. • Efficiency of the design relative to RBD, CRD. • Missing plot technique for one missing observation in case of LSD. <p>Factorial Experiments: Definition, Purpose & Advantages. 2^2, 2^3 Experiments.</p> <ul style="list-style-type: none"> • Calculation of Main & interaction Effects. Yates' method. Analysis of 2^2 & 2^3 factorial Experiments. Concept of Confounding. (partial and total) | 15 Lectures |

Distribution of topics for Practical

| | |
|-----------------------------------|----------------------------------|
| Course Code: RUSSTAP401(B) | |
| Sr. No. | Practical based on course |



| | |
|---|--|
| 1 | Analysis of Variance- One Way |
| 2 | Analysis of Variance- Two Way |
| 3 | Completely Randomized Design |
| 4 | Randomized Block Design |
| 5 | Latin Square Design. |
| 6 | Missing Observations in CRD, RBD & LSD |
| 7 | Factorial Experiments |
| 8 | Practical using Excel |

REFERENCES:

1. W.G. Cochran and G.M.Cox; Second Edition; John Wiley and Sons.: Experimental Designs
2. Oscar Kempthorne, John Wiley and Sons.: The Design and Analysis of Experiments
3. Douglas C Montgomery; 6th Edition; John Wiley & Sons.: Design and Analysis of Experiments
4. M.N.Das and N.C.Giri, 2nd Edition; New Age International (P) Limited; 1986: Design and Analysis of Experiments
5. Walter T Federer; Oxford & IBH Publishing Co. Pvt. Ltd.: Experimental Design, Theory and Application
6. S.C.Gupta and V.K.Kapoor; 3rd Edition; Sultan Chand and Sons (2001): Fundamentals of Applied Statistics
7. B.J. Winer, McGraw Hill Book Company.: Statistical Principles in Experimental Design

Course Code: RUSSTA403

Course Title: PROJECT MANAGEMENT AND INDUSTRIAL STATISTICS

Academic year 2023-24

COURSE OUTCOMES:

| COURSE OUTCOME | DESCRIPTION |
|-----------------------|---|
| | A student completing this course will be able to: |
| CO 1 | Create project networks depicting both probabilistic and deterministic time estimates to identify critical paths. Illustrate decision networks. |
| CO 2 | Accelerate activities to minimize project costs and regularly revise networks. |
| CO 3 | Develop diverse control charts for variables and attributes to establish standard benchmarks for future reference. |
| CO 4 | Devise a single sampling plan, analyze its characteristics, and comprehend the principles behind Double Sampling Plans. |
| CO 5 | Assess various types of games and appraise decision-making processes across different scenarios. |

DETAILED SYLLABUS

| Course Code/ Unit | Unit | Course/ Unit Title | Credits/ Lectures |
|--------------------------|----------------|--|--------------------------|
| RUSSTA403 | Unit I | CPM and PERT: <ul style="list-style-type: none"> Objective and Outline of the techniques. Diagrammatic representation of activities in a project: Gantt Chart and Network Diagram. Slack time and Float times. Determination of Critical path. Probability consideration in project scheduling. Project cost analysis. Updating. | 15 Lectures |
| RUSSTA403 | Unit II | Statistical Quality Control: <ul style="list-style-type: none"> Principles of control. Process quality control of variables. \bar{X} bar and R, \bar{X} bar and Sigma Chart and their uses. Problems involving setting up standards for future use. Introduction to Six sigma limits. Concept of Natural Tolerance Limits, Specification Limits and Detection of shift Principles of control. Process quality control of attributes p, c, np charts and their uses. p-chart and c-chart with variable sample size. Problems involving setting up standards for future use | 15 Lectures |

| | | | |
|-----------|----------|---|-------------|
| | | <ul style="list-style-type: none"> • Acceptance sampling plan • Single Sampling Plans (without curtailment). • OC function and OC curves. AQL, LTPD, ASN, ATI, AOQ, Consumer's risk, Producer's risk. • Double Sampling Plan (Concept only) | |
| RUSSTA403 | Unit III | <p>Game Theory and Decision Theory:</p> <ul style="list-style-type: none"> • <u>GAME THEORY:</u> Definitions of Two-person Zero Sum Game, Saddle Point, Value of the Game, Pure and Mixed strategy. Optimal solution of two-person zero sum games. Dominance property, Derivation of formulae for (2x2) game. Graphical solution of (2xn) and (mx2) games. • <u>DECISION THEORY</u> Decision making under uncertainty: Laplace criterion, Maximax (Minimin) criterion, Maximin (Minimax) criterion, Hurwicz α criterion, Minimax Regret criterion. Decision making under risk: Expected Monetary Value criterion, Expected Opportunity Loss criterion, EPPI, EVPI. Decision tree analysis. | 15 Lectures |

Distribution of topics for Practical

| Course Code: RUSSTAP401(C) | |
|----------------------------|--|
| Sr. No. | Practical based on course |
| 1 | PERT |
| 2 | CPM |
| 3 | Project cost analysis |
| 4 | Updating |
| 5 | Control Charts for attributes and Control Charts for variables |
| 6 | Acceptance Sampling Plans. |
| 7 | Game theory |
| 8 | Decision theory. |
| 9 | Practical using EXCEL and TORA software |



REFERENCES:

1. E.L. Grant. (2nd edition) McGraw Hill, 1988.: Statistical Quality Control
2. Duncan. (3rd edition) D. Taraporewala sons & company.: Quality Control and Industrial Statistics
3. Bertrand L. Hansen, (1973), Prentice Hall of India Pvt. Ltd.: Quality Control: Theory and Applications
4. Douglas Montgomery, Arizona State University. John Wiley & Sons, Inc. (6th Edition): Statistical Quality Control
5. Gupta S.C., Kapoor V.K., Fundamentals of Applied Statistics, Sultan Chand & Sons
6. Srinath. 2nd edition, East-west press Pvt. Ltd.: PERT and CPM, Principles and Applications
7. Kantiswaroop and Manmohan Gupta. 4th Edition; S Chand & Sons.: Operations Research
8. Richard Broson. 2nd edition Tata Mcgraw Hill Publishing Company Ltd.: Schaum Series book in O.R.
9. Maurice Sasieni, Arthur Yaspan and Lawrence Friedman, (1959), John Wiley & Sons.: Operations Research: Methods and Problems
10. J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.: Mathematical Models in Operations Research
11. S.D.Sharma. 11th edition, Kedar Nath Ram Nath & Company.: Operations Research
12. H. A. Taha, 6th edition, Prentice Hall of India.: Operations Research
13. J.K.Sharma, (2001), MacMillan India Ltd.: Quantitative Techniques for Managerial Decisions

Modality of Assessment

Theory Examination Pattern:

A) Internal Assessment- 40%- 40 Marks

| Sr No | Evaluation type | Marks |
|--------------|---|-----------|
| 1 | Class Test/ Project / Assignment / Presentation | 20 |
| 2 | Class Test/ Project / Assignment / Presentation | 20 |
| TOTAL | | 40 |

B) External Examination- 60%- 60 Marks

Semester End Theory Examination:

1. Duration - These examinations shall be of **two hours** duration.
2. Theory question paper pattern:

Paper Pattern:

| Question | Options | Marks | Questions Based on |
|----------|---------|-------|--------------------|
|----------|---------|-------|--------------------|



| | | | |
|--------------|--------------------------|-----------|----------|
| 1 | Any 2 out of 3 sub-parts | 20 | Unit I |
| 2 | Any 2 out of 3 sub-parts | 20 | Unit II |
| 3 | Any 2 out of 3 sub-parts | 20 | Unit III |
| TOTAL | | 60 | |

Practical Examination Pattern:

A) Internal Examination: 40%- 40 Marks

| Particulars | Marks |
|--|-----------|
| Journal and attendance | 5 |
| Projects based on primary / secondary data | 15 |
| Total | 20 |

B) External Examination: 60%- 60 Marks

Semester End Practical Examination:

Duration - These examinations shall be of **one and half hour** duration.

| Particulars | Paper |
|--|-----------|
| Exam (There shall be Three COMPULSORY Questions of 10 marks each with internal choice) | 30 |
| Total | 30 |

Overall Examination & Marks Distribution Pattern

Semester IV

| Course | RUSSTA401 | | | RUSSTA402 | | | RUSSTA403 | | | Grand Total |
|------------|-----------|----------|-------|-----------|----------|-------|-----------|----------|-------|-------------|
| | Internal | External | Total | Internal | External | Total | Internal | External | Total | |
| Theory | 40 | 60 | 100 | 40 | 60 | 100 | 40 | 60 | 100 | 300 |
| Practicals | 20 | 30 | 50 | 20 | 30 | 50 | 20 | 30 | 50 | 150 |
