



जननायक चन्द्रशेखर विश्वविद्यालय, बलिया-277001 (उ.प्र.)
Jananayak Chandrashekhar University, Ballia-277001 (U. P.)



FACULTY OF SCIENCE
Proposed Common Uniform Syllabus
For
Bachelor of Science (B.Sc.)/ Bachelor of Arts (B.A.)
Three Years Degree Course
Subject
STATISTICS
ACADEMIC SESSION -2020-21



FACULTY OF SCIENCE

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

B.Sc./B.A. (STATISTICS)

COURSE STRUCTURE

FIRST YEAR

Paper Number	Paper Name	External Marks	Internal Marks	Total Marks
Paper-101	Probability	80	20	100
Paper-102	Probability Distributions and Statistical Computation Still Life	80	20	100
Paper-103	Descriptive Statistics	80	20	100
Paper-104	Practical	80	20	100
			Total	400

SECOND YEAR

Paper Number	Paper Name	External Marks	Internal Marks	Total Marks
Paper-201	Statistical Interference	80	20	100
Paper-202	Survey Sampling	80	20	100
Paper-203	Analysis of Variance and Design of Experiment	80	20	100
Paper-204	Practical	80	20	100
			Total	400

THIRD YEAR

Paper Number	Paper Name	External Marks	Internal Marks	Total Marks
Paper-301	Non-parametric methods and Multivariate Analysis	80	20	100
Paper-302	Applied Statistics	80	20	100
Paper-303	Operations Research	80	20	100
Paper-304	Practical	80	20	100
			Total	400
		Grant Total		1200

Note: There will be 9 questions in each paper and candidate has to attempt only 5 questions. **Q.1** will carry short answers and will be **compulsory** based on units I - IV. **Two** questions will be set from **each unit**, out of which one question has to be attempted. Candidate must obtain minimum pass marks in Theory and Practical Examinations separately. * Based on papers I – III

Theory- All papers of 100 MM, each with following distribution of marks.

20- Internal assessment based on Project work/assignment/ activities/attendance.

80- Annual examination theory paper.

Practical-Practical in all three year of 100 marks, each with following distribution of marks-

20-Practical record and Viva-voce(held during annual practical exam)

80- Assessment of identification, evaluation and experimental skill during annual practical exam.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

B.Sc./B.A.(STATISTICS)

FIRST YEAR

80 Marks

PAPER – 101: Probability

Learning Objectives:

1. To understand the concept of probability along with basic laws and axioms of probability.
2. To understand the terms random, mutually exclusive and independence and their relevance.
3. To Identify the appropriate method (i.e. union, intersection, conditional, etc.) for solving a problem.
4. To apply basic probability principles to solve real life problems.
5. To understand the concept of random variable (discrete and continuous), concept of probability distribution.
6. To explain the expectation of a random variables and related problems.
7. To understand the various inequalities and law of numbers and their respective applications.

80 Marks

PAPER–102: Probability Distributions and Statistical Computation

Learning Objectives:

1. Define discrete distributions. Discuss appropriate distribution (i.e. binomial, negative binomial, Poisson, etc.) with their properties and application of discrete distribution models to solve problems.
2. Define continuous distributions. Discuss the appropriate distribution (i.e. uniform, exponential, normal, etc.) with their properties and application of continuous distribution models to solve problems.
3. To learn the formal definition of order statistics, derive the distribution function and probability density function of the r^{th} order statistic and joint distribution of r^{th} and s^{th} order statistics. To identify the application of theory of order statistics in real life problems.
4. To learn fundamentals of computers along with basics of some software packages for statistical computation.

80 Marks

PAPER – 103: Descriptive Statistics

Learning Objectives:

1. To develop the ability to apply fundamental concepts in exploratory data analysis.
2. To understand concepts of sample vs. population and difference between different types of data.
3. To interpret examples of methods for summarising data sets, including common graphical tools (such as boxplots, histograms and stemplots). Interpret histograms and boxplots.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

4. To assess the set are most appropriate method for highlighting interesting features of the data.
5. To learn to describe data with measures of central tendency and measures of dispersion. To understand measures of skewness and kurtosis and their utility and significance.
6. To learn the method of least squares for curve fitting to theoretically describe experimental data with a function or equation and to estimate the parameters associated with this model.
7. To understand the concepts of correlation and simple linear regression and perform correlation and regression analysis. Interpret results from correlation and regression.
8. To compute and interpret multiple and partial correlation coefficients. Find and interpret the least-squares multiple regression equation with partial slopes.
9. To calculate and interpret the coefficient of multiple determination (R^2). Explain the limitations of partial and regression analysis

80+20 Marks

PAPER – 104: Practical

Learning Objectives:

Practical application of theoretical concepts of paper 101, 102 and 103.

B.Sc./B.A.(STATISTICS) **FIRST YEAR DETAILED SYALLBUS**

PAPER – 101: Probability

UNIT – I

Random experiment, Trial, Sample point and Sample space, Events, Operations of events, Concept of equally likely, Mutually exclusive and Exhaustive events.

Definition of Probability: Classical, Relative frequency and Axiomatic approaches, Discrete Probability Space, Properties of Probability under Set Theory Approach, Independence of Events, Conditional Probability, Total and Compound Probability theorems, Bayes theorem and its Applications.

UNIT – II

Random Variables – Discrete and Continuous, Probability Mass Function (pmf) and Probability density function (pdf), Cumulative distribution function (cdf).

Joint distribution of two random variables, Marginal and Conditional distributions, Independence of random variables.

UNIT – III

Expectation of a random variable and its properties, Expectation of sum of random variables and product of independent random variables, Conditional expectation and related problems.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

UNIT – IV

Moments, Moment generating function (m.g.f.) & their properties, Continuity theorem for m.g.f. (without proof). Chebyshev's inequality, Weak law of large numbers for a sequence of independently and identically distributed random variables and their applications. (Statement Only)

REFERENCES:

1. David, S. (1994) : *Elementary Probability*, Cambridge University Press.
2. Meyer, P. (2017). *Introductory Probability and Statistical Applications (2nd ed.)*, New Delhi, Oxford & IBH Publishing Co. Pvt. Ltd.
3. Mood A.M., Graybill F.A. and Boes D.C. (2007). *Introduction to the Theory of Statistics (3rd ed.)*, New Delhi, Tata McGraw Hill Publishing Co. Ltd.
4. Mukhopadhyay, P. (1996). *Mathematical Statistics*, New Delhi, New Central Book Agency Pvt. Ltd.
5. Parzen, E.S. (1992). *Modern Probability Theory and its Applications*. Wiley Interscience.

PAPER – 102: Probability Distributions and Statistical Computation

UNIT – I

Discrete Probability Distributions: Binomial distribution, Poisson distribution (as limiting case of Binomial distribution), Hypergeometric, Geometric and Negative Binomial, Uniform and Multinomial distributions, fitting of Binomial, Poisson and Uniform distributions.

UNIT – II

Continuous Probability Distributions: Normal distribution and its properties, Standard Normal variate, Exponential, Gamma, Beta distributions. Cauchy, Laplace, Pareto, Weibull, Log normal distributions. Normal distribution as limiting case of Binomial distribution, fitting of Normal distribution.

UNIT – III

Order Statistics, Distributions of minimum, r^{th} and maximum order statistic, Joint distribution of r^{th} and s^{th} order statistics (in continuous case), Distribution of sample range & sample median for uniform and exponential distributions.

UNIT – IV

Introduction to Computer: Generation of Computer, Basic Structure of Computer, Digital computer and its peripherals, number systems (Binary, Octal, Hexadecimal Systems), Introduction of Statistical Computation using MS-Excel and SPSS.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

REFERENCES:

6. David, H.A. (1981). *Order Statistics* (2nd ed.), New York, John Wiley.
7. Meyer, P. (2017). *Introductory Probability and Statistical Applications* (2nd ed.), New Delhi, Oxford & IBH Publishing Co. Pvt. Ltd.
8. Parzen, E.S. (1992). *Modern Probability Theory and its Applications*. Wiley Interscience.
9. Sinha, P.K. and Sinha, P (2007). *Computer Fundamentals* (6th ed.), BPB Publications.
10. Verma, J.P. (2013). *Data Analysis in Management with SPSS Software*, New Delhi, Springer.

PAPER – 103: Descriptive Statistics

UNIT-I

Concept of Statistical population, Attributes and Variables (Discrete and Continuous), Different types of scales – Nominal, Ordinal, Ratio and Interval, Primary data – designing a questionnaire and schedule, collection of primary data, checking their consistency, Secondary data.

Presentation of data : Classification, Tabulation, Diagrammatic & Graphical Representation of Grouped data, Frequency distributions, Cumulative frequency distributions and their graphical representations, Histogram, Frequency polygon and Ogives. Stem and Leaf plot, Box Plot.

UNIT-II

Measures of Central tendency and Dispersion, Merits and Demerits of these Measures.

Moments and Factorial moments, Shephard's correction for moments, Skewness and Kurtosis and their Measures, Measures based on quartiles.

UNIT-III

Bivariate data, Principles of least squares, Most plausible values, Meaning of curve fitting, Fitting of straight line, parabola, logarithmic, power curves and other simple forms by method of least squares.

Bi-Variate frequency table, Correlation, Types of relationships, Scatter diagram, Karl-Pearson's Correlation Coefficient and its properties.

UNIT-IV

Rank correlation and its coefficient (Spearman and Kendall Measures), Regression analysis through both types of regression equations for X and Y variables.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

Regression coefficients and their properties, Relationship between correlation coefficients and regression coefficients.

Multiple and Partial correlations and Multiple Regression for three variables only.

REFERENCES:

1. Goon, A.M., Gupta, M.K. & Dasgupta, B. (2002). *Fundamentals of Statistics*, Vol. I. , Kolkata, The World Press.
2. Miller, I. and Miller, M. (2006). *John's E. Freund's Mathematical Statistics with Applications* (7th ed.), Pearson Education, Asia.
3. Weatherburn, C.E. (1961). *A First Course in Mathematical Statistics*, The English Language Book Society and Cambridge University Press.

PAPER – 104: Practical

The practical examination will be based on papers 101, 102 & 103 and will cover the following experiments.

List of Practical Experiments

1. Problems based on graphical representation of data by Histogram, Frequency polygons, frequency curves and Ogives, Stem and Leaf Plot, Box Plot.
2. Problems based on calculation of Measures of Central Tendency.
3. Problems based on calculation of Measures of Dispersion.
4. Problems based on calculation of Moments, Measures of Skewness and Kurtosis.
5. Problems based on fitting of curves by Method of least squares.
6. Problems based on determination of Regression lines and calculation of correlation coefficient – grouped and ungrouped data.
7. Problems based on calculation of multiple and partial correlation coefficients for three variables
8. Problems based on statistical Computation using MS-Excel and SPSS

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

B.Sc./B.A.(STATISTICS)

SECOND YEAR

80 Marks

PAPER – 201 : Statistical Inference

Learning Objectives:

1. To understand the concept of Sampling distribution.
2. To understand the difference between parameter & statistic and standard error & standard deviation.
3. To study the sampling distribution of the sum and mean.
4. Introduction to the t, f and chi-square distribution and to identify the main characteristics of these distributions.
5. To understand the concept of Point and Interval Estimation and discuss characteristics of a good estimator.
6. To understand various methods of estimations with problems.
7. To understand the terms like null and alternative hypotheses, two-tailed and one-tailed alternative hypotheses, significant and insignificant, level of significance and confidence, p value etc.
8. To understand the concept of MP, UMP and UMPU tests
9. To understand under what situations one would conduct the small sample and large sample tests (in case of one sample and two sample tests).

80 Marks

PAPER – 202 : Survey Sampling

Learning Objectives:

1. To understand the concept of sampling and how it is different from complete enumeration.
2. To understand the various probability and non-probability sampling methods along with estimates of population parameters
3. To discuss the situations where the various sampling techniques shall be used.
4. To understand sampling and non-sampling errors.
5. To discuss regression and ratio methods of estimation in simple random sampling (SRS).

80 Marks

PAPER – 203: Analysis of Variance and Design of Experiment

Learning Objectives:

1. To understand the concept of Analysis of variance (ANOVA).
2. To learn how to carry out the ANOVA for One way and Two way Classification.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

3. To learn how to carry out the post-hoc analysis.
4. To understand the concept of Design of experiment and its basic principles.
5. To understand the basic symmetric designs CRD, RBD and LSD with and without missing observations.
6. To understand the concept of factorial experiments and their practical applications.

80+20 Marks

PAPER – 204: Practical

Learning Objectives:

Practical application of theoretical concepts of paper 201, 202 and 203.

SECOND YEAR DETAILED SYALLBUS

PAPER – 201: Statistical Inference

UNIT – I

Sampling Distributions: The concept of sampling distribution, Parameter, Statistic and Standard error. The sampling distribution for the sum of independent random variables of Binomial, Poisson and Normal distribution, Central limit theorem, sampling distribution of $Z = [X - E(X)] / \text{standard deviation of } X$, Sampling distribution of t, f, and chi-square without derivations, Simple properties of these distributions and their interrelationship.

UNIT – II

Point estimation: Characteristics of a good estimator: Unbiasedness, consistency, sufficiency and efficiency. Method of Maximum Likelihood and properties of maximum likelihood estimators (without proof), Method of minimum Chi-square. Method of least squares and methods of moments for estimation of parameters, Problems and examples, Interval estimation.

UNIT – III

Statistical Hypothesis (Simple and Composite), Testing of hypothesis. Type –I and Type – II errors, Significance level, p-values, Power of a test, Definitions of Most Powerful (MP), Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests.

UNIT-IV

Test of significance: Large sample tests for (Attributes and Variables) proportions and means (i) for one sample (ii) for two samples

Correlation coefficient in case of (a) $p=p_0$ (b) $p_1=p_2$,

Small sample test based on t, f and chi-square distributions.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

REFERENCES:

1. Ferund J.E (2001) : Mathematical Statistics, Prentice Hall of India.
2. Goon, A.M., Gupta, M.K. & Dasgupta, B. (2002). *Fundamentals of Statistics*, Vol. I. , Kolkata, The World Press.
3. Hogg, R.V., McKean, J.W. & Craig, A.T. (2009). *Introduction to Mathematical Statistics* (6th ed.), Pearson.
4. Mood A.M., Graybill F.A. and Boes D.C. (2007). *Introduction to the Theory of Statistics* (3rd ed.), New Delhi , Tata McGraw Hill Publishing Co. Ltd.

PAPER – 202: Survey Sampling

UNIT – I

Sampling vs. Complete enumeration: Sampling units and Sampling frame, Precision and efficiency of estimators, Simple Random sampling with and without replacement, Use of random number tables in selection of simple random sample, Estimation of population mean and proportion, Derivation of expression for variance of these estimators, Estimation of variances, Sample size determination.

UNIT-II

Stratified random sampling, Problem of allocation, proportional allocation, optimum allocation. Derivation of the expressions for the standard error of the usual estimators when these allocations are used, Gain in precision due to Stratification, Role of sampling cost in the sample allocation, Minimization of variance for fixed cost.

UNIT-III

Systematic Sampling: Estimation of Population mean and Population total, standard errors of these estimators
Two stage sampling with equal first stage units: Estimation of Population mean and its variance
Non – sampling errors.

UNIT-IV

Regression and ratio methods of estimation in simple random sampling, Cluster sampling with equal clusters, Estimators of population mean and their mean square errors.

REFERENCES:

1. Cochran, W.G. (2008). *Sampling Techniques* (3rd ed.), Wiley India.
2. DesRaj and Chandhok, P. (1998). *Sample Survey Theory*, Narosa Publishing House.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

3. Murthy, M. N. (1977). *Sampling Theory and Statistical Methods*. Statistical Publishing Society, Kolkata.
4. Sukhatme, P.V., Sukhatme, B.V., Sukhatme, S. & Asok, C. (1984): *Sampling Theories of Survey with Applications*, IOWA State University Press and ISAS.

PAPER – 203: Analysis of Variance and Design of Experiment

UNIT-I

Analysis of Variance, One way classification, Assumptions regarding model, Two way classification with equal number of observations per cell, Duncan's multiple comparison tests.

UNIT-II

Principles of Design of Experiment: Randomization, Replication and Local Control, Choice of size and type of a plot using uniformity trials, Completely Randomized Design (CRD), Randomized block design(RBD), Concept and definition of efficiency of design, Comparison of efficiency between CRD and RBD.

UNIT – III

Latin Square Design (LSD), Lay-out, ANOVA table, Comparison of efficiencies between LSD and RBD; LSD and CRD

Missing plot technique: Estimation of missing plots by minimizing error sum of squares in RBD and LSD with one or two missing observations.

UNIT-IV

Factorial Experiments: General description of factorial experiments, 2^2 , 2^3 and 2^n factorial experiments arranged in RBD and LSD, Definition of Main effects and Interactions in 2^2 and 2^3 factorial experiments, Preparation of ANOVA by Yates procedure, Estimates and tests for main and interaction effects (Analysis without confounding).

REFERENCES:

Cochran, W.G. and Cox, G.M. (1959). *Experimental Design*, Asia Publishing House

1. Das, M.N. & Giri, N.C. (1986). *Design and Analysis of Experiments*, Wiley Eastern.
2. Goon, A.M., Gupta, M.K. & Dasgupta, B. (2005). *Fundamentals of Statistics* (8th ed.), Vol. II. , Kolkata, The World Press.
3. Kempthorne, O. (1965). *The Design and Analysis of Experiments*, John Wiley
4. Montgomery, D.C. (2008). *Design and Analysis of Experiments*, John Wiley

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

PAPER – 204: Practical

The practical examination will be based on papers 201, 202 and 203 and will cover the following experiments:

List of Practical Experiments

1. Problems based on fitting of Binomial, Poisson and Normal distributions to observed data and testing of goodness of fit.
2. Problems based on testing of independence of attributes in $m \times n$ contingency table and calculation of measures of association.
3. Problems based on t – test for (i) $\mu = \mu_0$ (ii) $\mu_1 = \mu_2$ (iii) $\alpha = \alpha_0$ (iv) $\beta = \beta_0$ (v) $\rho = 0$
4. Problems based on F-test for $\sigma_1^2 = \sigma_2^2$
5. Problems based on Fisher's Z-transformation and its use in testing (i) $\rho_1 = \rho_2$ (ii) $\rho = \rho_0$
6. Problems based on calculation of power curve for the test of $\mu = \mu_0$ against $\mu \neq \mu_0$ for a normal distribution with known variance.
7. Problems based on large sample tests.
8. Problems based on Analysis of variance in one-way and two-way classification (with and without interaction terms).
9. Problems based on analysis of a Latin square design.
10. Problems based on Analysis of variance in RBD and LSD with one or two missing observations.
11. Problems based on drawing a simple random sample with the help of table of random numbers.
12. Problems based on estimation of population means and variance in simple random sampling.
13. Problems based on Stratified random sampling for population means (proportional and optimum allocation).
14. Problems based on Ratio and regression estimation of population mean and total.
15. Problems based on Factorial Experiment Practical.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

B.Sc./B.A.(STATISTICS)

THIRD YEAR

80 Marks

PAPER – 301: Non-parametric Methods and Multivariate Analysis

Learning Objectives:

1. To understand the concept of distribution free tests (Non-parametric methods) for one and two sample cases.
2. To understand the methods to carry out the statistical analysis and testing of independence in case of Attributes (Qualitative Data).
3. To understand the basic concepts of vector space and matrices in order to study multivariate distribution.
4. To discuss the applications of multivariate normal distribution and Maximum Likelihood Estimates of mean vector and dispersion matrix.

80 Marks

PAPER – 302: Applied Statistics

Learning Objectives:

1. To become familiar with different aspects of Applied Statistics and their use in real life situations.
2. To introduce and define the concept of Time series along with its different components.
3. To define Index numbers and their applications along with different types of Index numbers.
4. To study various demographic methods and different measures of mortality and fertility. To understand the concept of life table and its construction.
5. To understand the concept of statistical quality control and different control charts for variables and attributes.

80 Marks

PAPER – 303: Operations Research

Learning Objectives:

1. To discuss the historical background and need of Operations research.
2. To Identify and develop operation research models from the verbal description of the real life problems.
3. To understand the mathematical tools that are needed to solve optimization problems.
4. To understand the algorithms to solve Linear programming problem, Transportation and Assignment problems, Replacement problems, Job sequencing, etc.
5. To understand the concept of Project management with CPM/PERT.
6. To introduce the concept of Stochastic process.

80+20 Marks

PAPER – 304: Practical

Learning Objectives:

Practical application of theoretical concepts of paper 301, 302 and 303.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

B.Sc./B.A.(STATISTICS) **THIRD YEAR DETAILED SYALLBUS**

PAPER – 301: Non-parametric Methods and Multivariate Analysis

UNIT – I

Non-parametric tests, Tests for randomness and test for goodness of fit. One sample tests : Sign test, Wilcoxon Signed rank tests.

Two sample tests : Run test, Kolmogorov – Smirnov’s test, Median test and Mann-Whitney U test.

UNIT – II

Attributes: Notion and Terminology, Contingency table, Class frequencies and Ultimate class frequencies, Consistency, Association of Attributes, Independence, Measures of association for 2X2 table, Chi-square, Karl Pearson’s and Tschuprow’s Coefficient of Association.

UNIT – III

Vector Space, Subspace, Linear Combination, Span, Linear Independence, Inner Product, Norm, Orthogonality, Dimension of Vector Space, Row and Column Rank, Inverse of a matrix.

UNIT – IV

Multivariate Normal Distribution, Marginal and Conditional Distributions, Moment Generating and Characteristics functions, Maximum Likelihood Estimation of Mean vector and Dispersion matrix.

REFERENCES :

1. Anderson, T.W. (2003) : *An Introduction to Multivariate Statistical Analysis* (3rd ed.), John Wiley.
2. Gibbons, J.D. and Chakraborty, S. (2003). *Non-Parametric Statistical Inference* (4th ed.), Marcel Dekker, CRC.
3. Johnston, J. (1972). *Econometric Methods* (2nd ed.), McGraw Hill International.
4. Mood A.M., Graybill F.A. and Bose D.C. (2007). *Introduction to the Theory of Statistics* (3rd ed.), New Delhi, Tata McGraw Hill Publishing Co. Ltd.

PAPER – 302: Applied Statistics

UNIT – I

Introduction & definition of time series, its different components, illustrations, additive and multiplicative models, determinations of trend, free hand curve, semi average methods, moving averages, methods of least squares, analysis of seasonal ratio to trend, link relative methods.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

UNIT – II

Index number – its definition, application of index number, price relative and quantity or volume relatives, link and chain relative, problem involved in computation of index number, use of averages, simple aggregative and weighted average method. Laspeyre's, Paasche's and Fisher's index number, time and factor reversal tests of index numbers, consumer price index.

UNIT – III

Demographic methods: Sources of demographic data – census, register, ad-hoc survey, hospital records, demographic profiles of Indian Censuses. Measurement of mortality, crude death rates, age specific death rates, infant mortality rates, death rate by cause. Measurement of fertility – crude birth rate, general fertility rate, age-specific birth rate, total fertility rate, gross reproduction rate, net reproduction rate, standardized death rates, age pyramid of sex composition, other measures of fertility. Logistic curve fitting and its use in population projection. Complete life table, its main features and construction.

UNIT – IV

Introduction, Process control, tool of statistical quality control, +3 control limits, principle underlying the construction of control charts, control charts for variables, X bar and R charts, construction and interpretation, control charts for attributes p and c charts construction and interpretation, Application of c charts.

REFERENCES :

1. Croxton F.E., Cowden D.J. and Klein, S. (1973). *Applied General Statistics*(3rd ed.), Prentice Hall of India Pvt. Ltd.
2. Gupta, S.C. and Kapoor, V.K. (2008). *Fundamentals of Applied Statistics* (4th ed.), Sultan Chand and Sons.
3. Montgomery D.C. (2009) : *Introduction to Statistical Quality Control* (6th ed.), Wiley India Pvt. Ltd.
4. Weisberg, S. (2005). *Applied Regression Analysis*(3rd ed.), Wiley.

PAPER – 303: Operations Research

UNIT – I

History and background of OR, General linear programming problems and their formulations.

Methods for solving LPP : Graphical Method, Simplex method, Big–M method, Two phase Method, Degeneracy and Duality in LPP.

UNIT – II

Transportation problem: North-west corner rule, Least cost method, Vogel's approximation method. Optimum solution: Stepping stone method, Method of Multipliers.

Assignment Problem: Hungarian Algorithm.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

UNIT – III

Replacement problems (Individual and Group).

Job sequencing : n jobs – 2 machines, n jobs – k machines, 2 jobs – n machines.

UNIT – IV

Networking Analysis (Project Management): PERT/CPM

Travelling Salesman Problem

Introduction to Stochastic Process and its Classification with Examples.

REFERENCES :

1. Medhi, J. (2009). *Stochastic Processes*, New Age International Pub.
2. Swarup, K., Gupta P.K. and ManMohan (2007). *Operations Research* (13th ed.) , Sultan Chand & Sons.
3. Taha, H.A. (2007). *Operations Research: An Introduction* (8th ed.), Prentice Hall of India.

PAPER – 304: Practical

The practical examination will be based on papers 301, 302 and 303 and will cover the following experiments:

List of Practical Experiments

1. Problems based on Non-parametric tests for one sample.
2. Problems based on Non-parametric tests for two samples.
3. Problems based on Contingency table.
4. Problems based on Consistency, Association of Attributes and Independence
5. Problems based on measures of association for 2X2 table
6. Problems based on Chi-square, Karl Pearson's and Tschuprow's Coefficient of Association.
7. Problems based on Rank and Inverse of a matrix.
8. Problems based on Mean vector and Dispersion matrix of a multivariate normal distribution.
9. Problems based on time series and its different components
10. Problems based on Index number.
11. Problems based on measurement of mortality and fertility.
12. Problems based on logistic curve fitting.
13. Problems based on life table.

JANNAYAK CHANDRASHEKHAR UNIVERSITY, BALLIA

14. Problems based on control charts for variables and attributes.
15. Problems based on linear programming problems and their formulations.
16. Problems based on Graphical Method, Simplex method, Big-M method, Two phase Method, Degeneracy and Duality in LPP.
17. Problems based on Transportation problem.
18. Problems based on Assignment problem.
19. Problems based on Replacement problems (Individual and Group).
20. Problems based on Job sequencing.
21. Problems based on PERT/CPM.
22. Problems based on Travelling Salesman Problem.