

**NORTH LAKHIMPUR COLLEGE (AUTONOMOUS)**  
**STATISTICS : CORE**  
**COURSE STRUCTURE**  
(For the students w.e.f. the session 2014-2015)

<b>SEMESTER</b>	<b>COURSE CODE</b>	<b>TITLE</b>	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
<b>I</b>	<b>CT-3-STS-101</b>	DESCRIPTIVE STATISTICS	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>
	<b>CP-2-STS-102</b>	PRACTICAL	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>II</b>	<b>CT-5-STS-203</b>	MATHEMATICS FOR STATISTICS-I	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>
<b>III</b>	<b>CT-4-STS-304</b>	PROBABILITY AND DISTRIBUTION-I	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>
	<b>CT-4-STS-305</b>	NUMERICAL METHODS	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>
	<b>CP-2-STS-306</b>	PRACTICAL	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>IV</b>	<b>CT-4-STS-407</b>	PROBABILITY AND DISTRIBUTION-II	<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>
	<b>CT-4-STS-408</b>	MATHEMATICS FOR STATISTICS-II	<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>
	<b>CP-2-STS-409</b>	PRACTICAL	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>V</b>	<b>CT-4-STS-510</b>	ESTIMATION	<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>
	<b>CT-4-STS-511</b>	TESTING OF HYPOTHESES AND SOFTWARE APPLICATIONS IN STATISTICS	<b>5</b>	<b>4</b>	<b>1</b>	<b>0</b>
	<b>CT-4-STS-512</b>	SAMPLE SURVEY & DEMOGRAPHY	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
	<b>CT-4-STS-513</b>	PRACTICAL	<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>
	<b>CT-4-STS-514</b>	PRACTICAL	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
<b>VI</b>	<b>CT-4-STS-615</b>	DESIGN OF EXPERIMENTS	<b>5</b>	<b>4</b>	<b>1</b>	<b>0</b>
	<b>CP-4-STS-616</b>	PRACTICAL	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
	<b>CT-4-STS-617</b>	APPLIED STATISTICS & PERATIONS RESEARCH	<b>4</b>	<b>4</b>	<b>0</b>	<b>0</b>
	<b>CP-4-STS-618</b>	PRACTICAL	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>
	<b>CP-4-STS-619</b>	PROJECT FOR DESSERTATION	<b>4</b>	<b>0</b>	<b>4</b>	<b>4</b>

<b>CT-3-STS- 101</b>	DESCRIPTIVE STATISTICS	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>

Introduction: Journey of Statistics till date

**UNIT 1:** Definition of Statistics, Limitations of Statistics; Statistical Data; Types of Statistical Data : Quantitative and Qualitative data; Discrete and Continuous data; Primary and Secondary data, Statistical population and sample, Measurement Scales: Nominal, Ordinal, Ratio, Interval scale (with examples); Classification and Tabulation data, Diagrammatic representation of data: Bar-diagrams, Pie diagrams, Pictograms. Stem-leaf display, Box-whisker plot Graphical representation of data: Histograms, Polygons, Ogives.

**UNIT 2:** Measures of central tendency and location; Mean (AM, GM and HM) mode, median: merits demerit and properties; quartiles, deciles, percentiles; determination of measures of locations graphically. Inter relationship: (i) mean, median and mode (ii) AM, GM and HM. Measures of dispersion and their properties. Coefficient of dispersion. Coefficient of variation Moments: Relation between moments about mean in terms of moments about any point. skewness and Kurtosis; different coefficients, Skewness vis-à-vis mean median and mode. Skewness and Kurtosis vis-à-vis Normal curve.

**UNIT 3 :** Bivariate Data; Scatter Diagram; Correlation Karl Pearson's coefficient of correlation and their properties & interpretation; Concept of coefficient of determination  $R^2$ , Rank correlation; Regression coefficients and their properties & interpretation; Regression lines. Fitting of linear regression.

**UNIT 4:** Analysis of Categorical Data : Consistency of categorical data. Independence and association of attributes. Various measures of association for two-way and three-way classified data.

<b>CP-2-STS- 102</b>	DESCRIPTIVE STATISTICS	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**Practical based on CT-3-STS-101**

**Text Books :**

**1. Bio-Statistics(Book)**

1. Medhi. J. (1982): Statistical Methods, New Age International (P) Ltd.
2. Goon A.M, Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Vol. I, World Press, Calcutta.
3. Gupta S.C. and Kapoor V.K. (2001): Fundamentals of Mathematical Statistics, Sultan Chand and Sons
4. Gupta S.C. (2008): Statistical Methods, Hindustan Publishing House.
5. Medhi. J. (1998) : Parisankhya Bigyan, New Age International (P) Ltd.
6. Choudhury, L. (2000) : Prambhik Parisankhya Bigyan, Book Land Guwahati

**References :**

7. Saxena H.C. (1981) : Examples in Statistics, Atma Ram & Sons
8. Agarwala, A.K. & Chakraborty, S. (2009) : Statistics : A tutorial text with PRACTICAL, Kalyani Publisher

**SEMESTER –II**

<b>CT-5- STS-203</b>	MATHEMATICS FOR	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
	STATISTICS-I	<b>5</b>	<b>4</b>	<b>1</b>	<b>0</b>

**UNIT 1:** Differentiation of one function with respect to another function, Differentiation involving parametric equations, Differentiation of implicit functions, Increasing and decreasing functions. Successive differentiation, Leibnitz theorem, Partial differentiation, Maxima and Minima of functions of one and two variables. Lagrange's undetermined multiplier technique ( Applications in Statistics).

**UNIT 2:** Definite integrals, Properties and applications, and Standard Reduction formulae; Double integrals in simple cases only; Jacobian of transformation, Laplace transformations, properties, and Statistical applications.

**UNIT 3:** Sets, operations on sets. Field, Sigma-field and Partitions; Limits of sequences of sets (arbitrary and monotone); Equivalence of sets, Countable sets and examples, union and Cartesian product of countable sets; set functions and properties.

**UNIT 4:** Convergence and divergence of series with non-negative terms, comparison test, D Alembert's ratio test, Raabe's test, Cauchy's Root test and Absolute convergence-Leibnitz test.

**Text Books :**

1. Malik S.C. & Arora S. (2000) : Mathematical Analysis, New Age International
2. Shanti Narayan and Mittal P K (...) : Differential Calculus, S Chand and Co.
3. Shanti Narayan and Mittal P K (...) : Integral Calculus, S Chand and Co.
4. Das B.C. & Mukherjee B.N. : Differential Calculus, U.N. Dhar & Sons
5. Das B.C. & Mukherjee B.N. : Integral Calculus, U.N. Dhar & Sons

**References :**

6. Apostol, T.M. (1985): Mathematical Analysis, Narosa Publishing House.
7. Khuri, A. I. (1983): Advanced Calculus with Applications in Statistics, Wiley.

8. Srieddon Ian N (1972) : The Use of Integral Transform, McGraw Hill Publications.  
 9. Raisinghanian M.D. : Laplace and Fourier Transforms, S. Chand & Co.

### SEMESTER–III

<b>CT-4-STS- 304</b>	<b>PROBABILITY AND DISTRIBUTION-I</b>	<b>CRED IT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>

**UNIT 1:** Random experiments, Events, Sample space, Event space, Algebra of events, Probability: Mathematical, Empirical and Set theoretic definitions. Addition theorem, Conditional Probability, Computation of probability by conditioning, Independence of events, Multiplication theorem, Bayes' theorem, and Illustrations.

**UNIT 3:** Random variables, Discrete and Continuous Random Variables, Probability Mass function, Probability Density function, Cumulative Distribution function – Properties. Mathematical Expectation of random variables and functions of r.v. and properties. Computation of expectation by conditioning, Generating functions: Moment generating function(MGF), Cumulant generating function(CGF), Characteristic function, Probability generating function(PGF): Definitions, properties, and illustrations.

**UNIT 4:** Bivariate distributions: Discrete and Continuous type - Joint Probability Function, Marginal and conditional distribution. Marginal and Conditional Expectation, Covariance, Correlation, and Regression.

#### Text Books :

1. Gupta S.C. and Kapoor V.K. (2001), Fundamentals of Mathematical Statistics, S Chand and Sons
2. Goon A.M, Gupta M.K., Das Gupta B. (1980): An Outline of Statistical Theory, Vol. I, 6th revised edition, World Press, Calcutta.
3. Medhi. J. (1998) : Parisankhya Bigyan, New Age International (P) Ltd.
4. Dutta, J. (....) : Sambhabita, Grantha Pith, Guwahati
5. Choudhury, L. (2000) : Prambhik Parisankhya Bigyan, Book Land Guwahati

#### References :

6. Rohatgi V.K. and Md. Ehsanes Saleh A.K.(2001): An Introduction to Probability and Statistics, Second Edition, Wiley
7. Sheldon M. Ross (2004) : Introduction to Probability Models, Elsevier
8. Mukherjee P. (1995) : Theory of Probability, New Central Book Agency
9. Saxena H.C. (1981) : Examples in Statistics, Atma Ram & Sons
10. Agarwala, A.K. & Chakraborty, S. (2009) : Statistics : A tutorial text with PRACTICAL, Kalyani Publisher
11. Hogg R. V. and Craig A. T. (1998); Introduction to Mathematical Statistics, 4/e, Academic press.
12. Mood A.M., Graybill F.A and Boes D.C. (1974): Introduction to the Theory of

Statistics, McGraw Hill.

<b>CT-4-ST-305</b>	NUMERICAL METHODS	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>

**UNIT 1:** Finite differences: Forward and backward differences, Differences of a polynomial. Operators :  $\Delta$ ,  $E$ ,  $\nabla$ ,  $\delta$  and  $\mu$  operators and their inter-relationships and related exercises .

**UNIT 2:** Interpolation with equal intervals: Newton's forward and backward difference formulae. Central differences: Gauss's forward and backward difference formulae, and Stirling's formula - Simple problems only. Interpolation with unequal intervals: Divided differences and their properties – Newton's divided difference formula, Lagrange's formula and Inverse interpolation- simple problems.

**UNIT 3:** Numerical Differentiation: Numerical Derivatives up to 2nd order only – simple problems. Numerical Integration: Trapezoidal rule - Simpson's 1/3 and 3/8 rules –Weddle's rule.

**UNIT 4:** Solution of Algebraic and Transcendental Equations: Bisection method, Regula- Falsi method, Iteration method, Newton-Raphson method.

**Text Books :**

1. Sastry S.S. (1998): Introductory Methods of Numerical Analysis, Prentice-Hall of India.
2. Mukhopadhyaya K. (1995) : Numerical Analysis, New Central Book Agency
3. Gupta P.P. & Malik G.S. (1980) : Calculus of Finite Differences & Numerical Analysis, Krishna Prakashan Mandir

**References :**

4. Scarborough B: Numerical Mathematical Analysis, Oxford University Press
5. Saxena H.C. (1980) : The Calculus of Finite Differences, S. Chand & Co.
6. Hilderbrand F.B. (1974) : Introduction to Numerical Analysis, McGraw Hill

<b>CP-2-ST-306</b>	PRACTICAL	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

Practicals based on topics of the Paper **CT-4- STS- 304 & CT-4-STs- 305**

### SEMESTER – IV

<b>CT-4-STs- 407</b>	PROBABILITY AND DISTRIBUTION-II	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>

**UNIT 1: Discrete Distributions:** Bernoulli, Binomial, Poisson, Negative Binomial, Geometric, Hyper-geometric. Properties, mean, Variance, Moments, PGF, MGF, CGF, and CF.

**UNIT 2: Continuous distribution:** Uniform, Normal, Lognormal, Exponential, Gamma, Beta, Cauchy, Laplace: Properties, Mean, Variance, Moments, MGF, CGF, CF. Bivariate Normal distribution: MGF, Marginal and conditional density functions.

**UNIT 3: Sampling Distributions** - sample mean and variance for normal distribution, Definition of Chi-square distribution, t distribution and F distribution. Inter-relation among Chi-square, t, and F distributions. Order statistics and their distributions – Distribution function of rth order statistic.

**UNIT 4: Markov inequality,** Chebyshev's inequality - Convergence in probability and in Distribution, CLT, DeMoivre - Laplace Theorem, Lindeberg-Levy theorem, Convergence of binomial to Poisson and of binomial to normal.

#### **Text Books :**

1. Mood A.M., Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
2. Goon A.M, Gupta M.K., Das Gupta B. (1980): An Outline of Statistical Theory, Vol. I, 6th revised edition, World Press, Calcutta.
3. Rohatgi V.K. and Md. Ehsanes Saleh A.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley.
4. Gupta V. K. and Kapoor S. C. (2000) : Fundamentals of Mathematical Statistics, S Chand and Sons
5. Mukherjee P. (2006) : Mathematical Statistics, Books & Allied (P) Ltd., Kolkata

#### **References :**

6. Hogg R.V. and Craig A.T.(1998): Introduction to Mathematical Statistics, Collier Macmillan Press.
7. Sheldon M. Ross (2004) : Probability Model, Elsevier
8. Jhonson NL, Kemp AW,Kotz S (2005) : Univariate Discrete Distribution, Wiley
9. Jhonson NL, Kotz S, Balakrishnan N (2004) : Continuous Univariate Distribution, Vol. I & Vol. II., Wiley

<b>CT-4-ST- 408</b>	MATHEMATICS FOR STATISTICS-II	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>

**UNIT 1:** Differentiability of Functions, Darboux theorem\*, Rolle's theorem\*, Mean value theorem\* for derivatives, Expansion of function: Taylor's Series expansion\*, Maclaurin's\* expansion.

**UNIT 2:** Definition of the Riemann Integral, existence of the Riemann integral. Improper Integrals their convergence using standard tests, Beta and Gamma Integrals: Definitions convergence of Beta and Gamma integrals - recurrence formula for Gamma integral - Properties of Beta integral - Relation between Beta and Gamma integrals, and Statistical applications.

**UNIT 3:** Vector space over real field, linear combination of vectors, subspaces, Examples in  $R^n$  with geometrical interpretation, Linear dependence and independence of vectors, Dimension and basis of a vector space, and illustrations.

**UNIT 4:** Matrices: Elementary, scalar, symmetric, skew symmetric, Hermitian, skew-Hermitian, unitary, triangular, equivalent and similar matrices (only definitions). Transpose and conjugate of a matrix, Rank of a matrix, Determination of rank through elementary transformations. Solutions of systems of linear equations. Inverse of a matrix. Characteristics equation, Eigen Vectors and Eigen Values, Spectral-decomposition theorem\*, Cayley- Hamilton theorem\*. Quadratic-forms definition and classification only. Statistical applications.

**\*Sans derivation**

**Text Books :**

1. Malik S.C. & Arora S. (2000) : Mathematical Analysis, New Age International.
2. Shanti Narayan and Mittal P K (...) : Differential Calculus, S Chand and Co.
3. Shanti Narayan and Mittal P K (...) : Integral Calculus, S Chand and Co..
4. Shanti Narayan, (1998): Matrix Algebra, S. Chand & Co.
5. Vasistha A.R. (2000) : Modern Algebra, Krishna Prakashan
6. Vasistha A.R. (2000) : Matrix Algebra Krishna Prakashan

**References :**

7. Biswas S. (1997) : A Text Book of Matrix Algebra, New Age International , New Delhi
8. Somasundaram D. and Choudhary B. (2002): A first course in Mathematical Analysis, Narosa Publishing house
9. Goldberg R. R. (1970) : Methods of Real Analysis, Oxford & IBH.
10. Apostol T. M. (1985): Mathematical Analysis, Narosa Publishing House.
11. Deshpande, J. V. (1981):Text Book of Mathematical Analysis, Tata McGraw Hill.
12. Searle, S. R. (1982): Matrix Algebra Useful for Statistics, Wiley,
13. Khuri, A. I. (1983): Advanced Calculus with Applications in Statistics, Wiley.
14. Goldberg, R. R. (1970): Methods of Real Analysis, Oxford and IBH
15. Kumaresan S. (2008) : Linear Algebra ( A Geometric Approach), Prentice Hall

<b>CP-2-ST5-409</b>	<b>PRACTICAL</b>	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

Practicals based on topics of the paper **CT-4-ST5- 407**

### SEMESTER- V

<b>CT-4-ST5-510</b>	<b>ESTIMATION</b>	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>

**UNIT 1:** Point estimation: Properties of estimators. Unbiasedness, Asymptotically Unbiased Estimator, Minimum Variance Unbiased Estimator (UMVUE), Uniqueness of MVUE : Concept of efficiency- Cramer-Rao inequality\* and its uses, Simple problems. Consistent estimators Properties of consistent estimators, sufficient condition for consistency. Data reduction: Concept of sufficient statistics with illustration - Sufficient Statistic and Factorization theorem\*, Rao-Blackwell theorem\* and illustrations.

**UNIT 2:** Methods of estimation: Method of Maximum Likelihood, Properties of Maximum Likelihood Estimators \*, Method of moments, Method of Minimum Variance, Method of Least Squares & Method of Minimum Chi-square –illustrations and applications.

**UNIT 3:** Interval Estimation: Concepts of Confidence Interval and Confidence Coefficient, Confidence Intervals for the parameters of univariate normal and exponential distribution. Large sample confidence intervals for proportions , means and variances .

**\*Sans derivation**

**Text Books :**

1. Goon A.M, Gupta M.K., Das Gupta B. (1980): An Outline of Statistical Theory,



Vol. 2, 6th revised edition, World Press, Calcutta.

2. Mukherjee P. (2006) : Mathematical Statistics, Books & Allied (P) Ltd., Kolkata

3. Saxena H.C. & Surendram P.U. (1985) : Statistical Inference, S. Chand & Co.

**References :**

4. Hogg R.V. and Craig A.T. (1998): Introduction to Mathematical Statistics, Collier Macmillan Press.

5. Mood A.M., Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.

6. Hogg R.V. and Tanis E.A. (2001): Probability and Statistical Inference, Pearson Education Asia.

7. Rohatgi V.K. and Md. Ehsanes Saleh A.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication.

8. Rao C.R. (1973): Linear Statistical Inference and Its Application, Revised Edition, Wiley Eastern.

9. Kale B.K. (1999) : A First Course on Parametric Inference, Narosa

<b>CT-4-STS- 511</b>	TESTING OF HYPOTHESES AND SOFTWARE APPLICATIONS	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>5</b>	<b>4</b>	<b>1</b>	<b>0</b>

**UNIT 1:** Simple and composite hypotheses, Null and Alternative Hypotheses, Types of errors, Critical region, p-value, Power of a test and most powerful(MP) test. Neyman-Pearson Lemma, Simple problems. Uniformly most powerful (UMP) tests : definition and simple applications. Likelihood Ratio (LR) tests : Definition and LR tests for means and variance (one and two sample problem only with normal distribution).

**UNIT 2:** Test of significance: Exact and large sample tests based on Normal, Student's- t, Chi-square and F-distribution. Testing the means, proportions, variances and correlation coefficient. Chi-square test for categorical data.

**UNIT 3:** Sequential tests : What sequential test is and its essence. Wald's Sequential probability ratio test (SPRT) with illustrations. Approximate expression for Operating Characteristic (OC) and Average sample number (ASN) functions for tests on parameters of binomial and Poisson distributions.

**UNIT 4:** Non-parametric tests: Non-parametric vs parametric test, Run test, Sign test, median test, Wilcoxon Signed rank test, Mann Whitney U test. Goodness of fit tests : Kolmogrov-Smirnov test, Chi square test.

**UNIT 5:** Statistical software applications: Introduction to softwares useful in Statistical analysis; R Package: Introduction to R, advantages of R, R-console, objects, workspace, using R as a calculator, objects, commands, operators; Data input: R statements and functions- assignment,

combine, rep, seq ,csan , data.frame, and matrix; Common built in functions-length, dim, max, sum, cumsum, mean, median, min, range, sd, var,sort, diff, table, attach, detach, and search; Simple graphics: plot, hist, boxplot, stripchart, barplot, stem, lines, abline, text, and legend. Arguments of graphical functions: main, xlab, ylab, type, pch, lty, cex, and fill.

**Text Books :**

1. Mood A M, Graybill F A and Boes D C (1974): Introduction to Theory of Statistics, McGraw Hill Publishing Co., New York
2. Goon A.M, Gupta M.K., Das Gupta B. (1980): An Outline of Statistical Theory, Vol. 2, 6th revised edition, World Press, Calcutta.
3. Mukherjee P (2006): Mathematical Statistics, Books and Allies (P) ltd, Kolkata.

**References :**

5. Hogg R V and Craig A T (1998): Introduction to Mathematical Statistics, McGraw Hill Publishing Co., New York.
6. Hogg R.V. and Tanis E.A. (2001): Probability and Statistical Inference, Pearson Education Asia.
7. Rohatgi V.K. and Md. Ehsanes Saleh A.K. (2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication.
8. Freund J.E. (2000): Mathematical Statistics, Prentice Hall of India.
9. Kanji G. (2006) : 100 Statistical Test, SAGE
10. Lehman, E.L. (1975) : Nonparametric statistical method, based on ranks, Holden

<b>CT-4-ST5- 512</b>	SAMPLE SURVEY AND DEMOGRAPHY	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**UNIT 1:** Concepts of population and sample; Need for sampling; Descriptive and analytical surveys, Census and Sample Surveys- advantages and disadvantages. Principal steps in a sample survey, Probability and Non-probability sampling, Sampling and Non-sampling errors.

**UNIT 2:** Simple random sampling, properties of the estimates and their variances, Finite population correction, estimation of the standard error, confidence limits, Sampling for proportions, variances of the sample estimates, estimation of sample size.

**UNIT 3:** Stratified random sampling : Properties of the estimates and their variances, Optimum allocation, Proportional allocation, Advantages and disadvantages, Variance of the sample estimates. Systematic sampling : Definition, Variance of the estimated mean. Populations with linear trend. Single stage Cluster sampling with clusters of equal sizes. Relative precision of systematic, stratified random and simple random sampling.

**UNIT 4:** Sources of demographic data in India: census, vital events, registration, and survey. Measures of mortality: crude and specific rates (wrt age, sex), infant mortality rate (IMR), Direct and indirect standardization of death rates. Complete and Abridged life tables, structure, interrelationship among life functions, uses of life table. Measures of fertility: CBR ASBR GFR TFR. Concepts of Population projection.

**Text Books :**

1. Cochran W.G. (1999) : Sampling Techniques, Wiley Eastern Ltd.
2. Gupta S.C. and Kapoor V.K. (2001) : Fundamentals of Applied Statistics, Sultan Chand and Sons.
3. Mukherjee P (...) : Theory and Methods of Survey Sampling ,Prentice Hall of India.

**References :**

4. Singh Daroga and Choudhary F.S. (1986) : Theory and analysis of Sample Survey Designs, Wiley Eastern Ltd.
5. Gupta S.C. and Kapoor V.K. (2001) : Fundamentals of Applied Statistics, Sultan Chand and Sons.
6. Sukhatme Pandurang V. and Sukhatme Balkrishna V. (1970): Sampling Theory of Survey with application, Asia Publication House.

<b>CT-4-ST-513</b>	PRACTICAL	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>

Practicals based on topics of the Papers

**CT-4-ST-510 & CT-4-ST-511**

<b>CT-4-ST-514</b>	PRACTICAL	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

Practicals based on topics of the Paper **CT-4-ST-512**

**SEMESTER – VI**

<b>CT-4-ST-615</b>	DESIGN OF EXPERIMENTS	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>5</b>	<b>4</b>	<b>1</b>	<b>0</b>

**UNIT 1:** Analysis of variance, One way classification, Two way classification, Two way classification with m observations per cell, Statistical analysis of the models. Analysis of covariance one-way layout.

**UNIT 2:** Principles of design of experiment, completely randomized design, randomized block design, Latin square design, assumptions, model, hypotheses, least square estimates of the parameters and statistical analysis. Missing plot technique in the case of one or two missing observations in RBD and LSD.

**UNIT 3:** Factorial experiments 22, 23 experiments only. Confounding in 23 factorial experiments - Total and partial confounding. Split plot experiments.

**UNIT 4:** Time series: Components of a time series, Additive and Multiplicative Models, Resolving the components of a time series, Evaluation of trend by least squares method, Methods of moving averages, Seasonal indices: Simple average, Ratio to moving average, Ratio to trend, and link relative method. Random movements-Variate difference method.

**Text Books :**

1. Cochran, W.G. and Cox, G.M. : Experimental Design, Asia publishing house.
2. Gupta S.C. and Kapoor V.K. (2001): Fundamentals of Applied Statistics, Sultan Chand & Sons.
3. Goon A.M, Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
4. Montgomery D.C.(2001): Design and Analysis of Experiments, John Wiley.

**References :**

5. Das.M.N and Giri.N.C (1986): Design and Analysis of Experiments, Wiley Eastern Limited.
6. Kempthorne Oscar: Design and Analysis of Experiment, Wiley Eastern Private Limited.

<b>CT-4-ST-516</b>	PRACTICAL	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

Practicals based on topics of the Paper **CT-4-ST-615**

CT-4-STS- 617	APPLIED STATISTICS & OPERATIONS RESEARCH	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>4</b>	<b>3</b>	<b>1</b>	<b>0</b>

**UNIT 1: Index number:** definition and its construction; Price and quantity indices, Criteria of an ideal index number. Common index numbers-Laspeyre's, Paasche's, Fisher's, Marshall-Edgeworth. Fixed and Chain base index numbers. Cost of living index number, wholesale price index, Concepts of Inflation and deflation. Uses of Index numbers.

**UNIT 2:** Theory and analysis of consumer's demand, Laws of demand and supply, Elasticity coefficients, Different forms of demand functions, estimation of demand curves. Utility function and its maximization.

**UNIT 3: Statistical Quality control:** Development of control charts, Causes of variation, control limits, sub grouping, summary of out of control criteria. Charts for attributes: p- chart, np-chart, c-chart. Charts for variables:  $\bar{X}$  & R and  $\bar{X}$  & S – charts. Acceptance sampling by attribute (single sampling)

**UNIT 4: Operations Research:** History of Operations Research, Problems of Operations Research, Formulation of linear programming problems. Graphical and simplex methods of solution (without artificial variables) of linear programming problems. Transportation problem (TP): North-West corner rule, Vogel's approximation method, and least cost entry rule and, Degeneracy in TP. Assignment problem and its solution.

**Text Books :**

1. Goon A.M, Gupta M.K., Das Gupta B. (1991): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
2. Kapoor V.K. and Gupta S.C. (1978): Fundamentals of Applied Statistics, Sultan Chand ans Sons.
3. Saluja M.R. (1972): Indian official Statistical Systems, Statistical Publishing Society, Calcutta and The Indian Econometric Society, Hyderabad.
4. Mukherjee P (1999): Applied Statistics, New Central Book Agency Pvt. Ltd., Calcutta.
5. Montgomery D.C. (2001) : Introduction to Statistical Quality Control, Wiley
6. Ram Kumar R. : Technical Demography, Wiley

**References :**

7. Coxton F.E, Cowden D.J and Kelin S (1973): Applied General Statistics, Prentice Hall of India.
8. Guide to current Indian Official Statistics. Central Statistical Organization, Govt. of

India

9. Srinivasan K. (1998) : Basic Chemographic Techniques and Applications, SAGE  
21

10. Misra B.D. (.... ) : An Introduction to the Study of Population, South Asian  
Publishers

11. Grant E.L. (1964) : Statistical Quality Control, Wiley

12. Duncan A.J. (1974) : Quality Control and Industrial Statistics, Taraporewalla &  
Sons

13. Asthana B.N., Srivastava SS : Applied Statistics of India, Chaityanya Publishing  
House.

<b>CP-4-STS-618</b>	<b>PRACTICAL</b>	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

**Practical based on topics of the paper CT-4-STS- 617**

<b>CP-4-STS-619</b>	<b>PROJECT / DESSERTATION</b>	<b>CREDIT</b>	<b>L</b>	<b>T</b>	<b>P</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

