Syllabus For B.A./B.Sc.

Statistics

(School of Sciences)

Under the

Choice Based Credit system

(CBCS)

2018

Revised in 2018

From the Academic Session 2019-20

H.N.B.Garhwal Central University, Srinagar (Garhwal)

B.A./B.Sc. Ist Semester

Course No. SOS/STAT/UG/C-101

Core Course - Credit 4

Core 1.1: Statistical Methods

Origin and development of Statistics, Meaning and definitioins of Statistics, Importance, Limitations and Scope of Statistics.

Types of data: Discrete and continuous data, Frequency and non-frequency data, Different types of scales, Primary data (designing a questionnaire and schedule), Secondary data (major sources including some government publication).

Presentation of data: Classification, Tabulation, diagrammatic and graphical representation of grouped data, frequency and cumulative frequency distribution and their applications, histogram, frequency polygon, Ogives, stem and leaf charts, box plot.

Concept of central tendency and Dispersion, its measures, Merits and Demerits of these measures, partition values, moments and factorial moments, Sheppard's correction for moments (without derivation), Skewness, kurtosis and their measures, Measures based on Quartiles.

References:

1. Goon Gupta & Dasgupta: Fundamentals of Statistics, Volume I.
2. Yule, G.U. and Kendall, M.G.: An Introduction to the theory of statistics.
3. C. E. Weatherburn: Mathematical Statistics.
4. Fundamentals of Mathematical Statistics: SC Gupta & VK Kapoor
5. Mathematical Statistics: Kapoor & Saxena
6. Mathematical Statistics: OP Gupta & BD Gupta

Core 1.2: Probability Theory

Introduction, Short History, Basic Terminology, Random Experiment, Trail, Sample Point, Sample space, Definitions of Equally- likely, Mutually- Exclusive and exhaustive Events, Mathematical (or classical or 'a priori') Probability-limitations of Mathematical Probability, Statistical (or Empirical) Probability-Limitations of Empirical Probability, Subjective Probability, Mathematical Tools: Preliminary Notions of Sets-Sets and Elements of Sets,

Operations on sets, Algebra of sets., Axiomatic approach to probability- Algebra of Events. Some Theorems on Probability-Addition theorem of Probability, Extension of Addition theorem of Probability to n Events, Boole's Inequality, Conditional Probability, Conditional Probability Theorems, Multiplication Theory of Probability, Independent Events, Multiplication theorem of Probability for Independent Events-Extension of Multiplication theorem of Probability to n Events, Pair Wise Independent Events-Mutually Independent Events, Probability of Occurrence of At Least One of the Events. Bayes' Theorem and its Applications, Geometrical Probability.

References:

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics.
2. R.V. Hogg, A.T. Craig and J.W. Mckean, Introduction to Mathematical Statistics.
3. A.M. Mood, F.A. Graybill and D.C. Boes: Introduction to the Theory of Statistics.
4. Parzen, E.S.: Modern Probability Theory and Its Applications.
5. Meyer,P.: Introductory Probability and Statistical Application

Core 1.3: Numerical Analysis:

Calculus of finite differences, Operators, Separation of symbols, Examples and problems. Interpolation: Interpolation for equal and unequal intervals, Newton's forward and backward formulae. Central difference formulae, Newton's divided difference formulae for interpolation. Lagrange's interpolation formulae, Stirlings and Bessels formula- Derivations and Problems.

Numerical Integration: Derivation of general quadrature formula for equidistant ordinates. Derivation of trapezoidal, Simpson's 1\3rd and 3\8th rules. Weddle's rule. Real roots of a numerical equation by method of iteration.

References:

1. Freeman: Finite Differences.
2. Scarborough: Numerical Analysis.
3. S.S. Sastry: Introductory Methods of Numerical Analysis.
4. Jain, M.K., Iyengar, SRK and Jain R.K.: Numerical Methods For Scientific And Engineering Computations.
5. Numerical Analysis: Goyal & Gupta.

PRACTICAL/LAB WORK: Credit 2

List of Practical:

1. Graphical representation of data.
2. Problems based on measures of central tendency.
3. Problems based on measures of dispersion.
4. Problems based on combined mean and variance and coefficient of variation.
5. Problems based on moments, Skewness and kurtosis.
6. Problems based on probability.
7. Problems based on Baye's theorem.
8. Construction of forward difference tables and divided difference tables.
9. Interpolation by Newton's forward difference formula for equal intervals.
10. Interpolation by Newton's divided difference formula for unequal intervals.
11. Interpolation by Lagrange's formula for unequal intervals.
12. Approximate integration (Trapezoidal rule, Simpson's one-third rules, Simpson's three-eighth rule, Weddle's rule),

And

Other practicals based on Core Courses 1.1, 1.2 and 1.3.

B.A./B.Sc. IInd Semester

Course No. SOS/STAT/UG/C-201

Core Course -Credit 4

Core 2.1: Descriptive Statistics:

Bivariate Data: Scatter diagram, Correlation-Introduction, Meaning of Correlation, Karl Pearson's Coefficient of Correlation- Limits for Correlation Coefficient, Assumptions Underlying Karl Pearson's Correlation Coefficient, Calculation of the Correlation coefficient for a Bivariate Frequency Distribution, Probable Error of Correlation Coefficient, Rank Correlation- spearman's Rank Correlation Coefficient, Tied or Repeated Ranks, repeated Ranks (continued).

Regression-Introduction, Linear regression- obtaining lines of Regression, Regression Coefficients, Properties of Regression Coefficients, Angle between Two Lines of Regression, Standard Error of Estimate or Residual Variance, Correlation Coefficient between Observed and Estimated Values.

Correlation Ratio, Intra-class Correlation, Multiple and Partial Correlation- Yule's Notation, Plane of Regression, Properties of Residuals- Variance of the Residual, Coefficient of Multiple Correlation- Properties of Multiple Correlation Coefficient, Coefficient of Partial Correlation.

References:

1. GoonGupta & Das Gupta: Fundamentals of Statistics, Volume I.
2. Yule, G.U. and Kendall, M.G.: An Introduction to the theory of statistics.
3. C. E. Weatherburn: Mathematical Statistics.
4. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics.
5. R.V. Hogg, A.T. Craig and J.W. Mckean: Introduction to Mathematical Statistics.

Core 2.2: Advance Probability Theory:

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.

Expectation of a random variable (r v) and its properties, Expectation of sum of random variables and product of independent random variables, Conditional expectation.
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 and Strong law of large Numbers, Central Limit Theorem for a sequence of independently and identically distributed random variables and their applications.

References:

1. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics.
2. R.V. Hogg, A.T. Craig, and J.W. Mckean: Introduction to Mathematical Statistics.
3. A.M. Mood, F.A. Graybill and D.C. Boes: Introduction to the Theory of Statistics.
4. V.K. Rohtagi and A.K. Md. E. Saleh: An Introduction to Probability and Statistics.
5. Meyer, P.: Introductory Probability and Statistical Applications.
6. Parzen, E.S.: Modern Probability Theory and Its Applications.

Core 2.3: Theory of Attributes:

Variables versus Attribute, Attributes- Notion and terminology, contingency table, Classes and class frequencies and ultimate class frequencies, Order of Classes and Class frequencies, Relation between class frequencies, Consistency of data, Conditions for consistency of data. Independence of Attributes, Criterion for Independence, Association of attributes, Measure of association for 2x2 table. Chi-square, Karl Pearson's and Tschuprow's coefficient of association. Contingency tables with ordered categories, Partial Association, Conditions and Notations for Partial Association.

References:

1. Fundamentals of Mathematical Statistics: SC Gupta & VK Kapoor.
2. Mathematical Statistics: Kapoor & Saxena.
3. Mathematical Statistics: OP Gupta & BD Gupta.

PRACTICAL/LAB WORK: Credit 2

List of Practical:

1. Karl Pearson correlation coefficient.

2. Correlation coefficient for a bivariate frequency distribution.

3. Lines of regression, angle between lines and estimated values of variables.

4. Spearman rank correlation with and without ties.

5. Partial and multiple correlations.

6. Problems based on Theory of Attributes.

And

Other practicals based on Core Courses 2.1, 2.2 and 2.3.

B.A./B.Sc. IIIrd Semester

Course No. SOS/STAT/UG/C-301

Core Course - Credit 4

Core 3.1: Probability Distributions:

Univariate distributions: Discrete - Binomial, Poisson, Hypergeometric, Geometric and Negative Binomial, Uniform distributions with properties. Continuous- Uniform, Normal, Exponential, Gamma, Beta, Cauchy distributions with properties.

Distributions of function of random variables: Distribution of sum, product and quotient of two variables.

References:

1. Fundamentals of Mathematical Statistics: S C Gupta & V K Kapoor.
2. Goon Gupta & Das Gupta: Fundamentals of Statistics. Volume II.

Core 3.2: Sampling Distributions:

Exact sampling distributions - Chi-square ($\chi 2$) Distribution: Introduction, Derivation of the Chi-square ($\chi 2$) Distribution, M.G.F. of Chi-square distribution, Cumulant Generating Function of $\chi 2$-Distribution, Limiting From of $\chi 2$-Distribution, Characteristic Function of $\chi 2$ Distribution, Mode and Skewness of $\chi 2$-Distribution, Additive Property of $\chi 2$-Variates, Chi square Probability Curve Student's 't' Distribution- Derivation of Student's t-distribution, fisher's 't', Distribution of Fisher's 't', Constants of t-distribution, Limiting Form of t distribution, Graph of t-distribution, Critical Values of t, F-distribution- Derivation of Snedecor's F-distribution, Constants of F-distribution, Mode and Points of Inflexion of F distribution , Relation Between t and F Distributions, Relation Between F and $\chi 2$ Distributions, Fisher's z-Distribution.

Tests based on $\chi 2$, t and F distributions. Large Sample Tests.

Bivariate Normal Distribution- Moment Generating Function of Bivariate Normal Distribution, Marginal Distributions of Bivariate Normal Distribution, Conditional Distributions of Bivariate Normal Distribution

References:

1. Parzen, E.S.: Modern Probability Theory and its Applications.
2. Meyer, P.: Introductory Probability and Statistical Applications.
3. Stirzekar David (1994): Elementry Probability.
4. Mood A.M., Graybill F.A. and Boes D.C. (1974): Introduction to the theory of Statistics.
5. Fundamentals of Mathematical Statistics: SC Gupta & VK Kapoor.
6. Goon Gupta & Das Gupta: Fundamentals of Statistics, Volume I.

Core 3.3: Order Statistics:

Order Statistics. Distributions of minimum, rth and maximum order statistic. Joint distribution of rth and sth order statistics (in continuous case), Distribution of sample range & sample median, for uniform and exponential distributions. Confidence interval of quantiles of order p, Tolerance and Coverages.

References:

1. Parzen, E.S.: Modern Probability Theory and its Applications.
2. Meyer, P.: Introductory Probability and Statistical Applications.
3. Stirzekar David (1994): Elementry Probability.
4. Mood A.M., Graybill F.A. and Boes D.C. (1974): Introduction to the theory of Statistics.
5. Fundamentals of Mathematical Statistics: SC Gupta & VK Kapoor.
6. A.M. Goon, M.K. Gupta and B. Das Gupta: An Outline of Statistical Theory, Volume I.

PRACTICAL/LABWORK: Credit 2

List of Practical:

1. Problems based on Educational Statistics
2. Fitting of binomial distributions for n and p = q = ½.
2. Fitting of binomial distributions for given n and p.
3. Fitting of binomial distributions after computing mean and variance.
4. Fitting of Poisson distributions for given value of lambda.
5. Fitting of Poisson distributions after computing mean.
6. Fitting of negative binomial.
7. Fitting of suitable distribution.
8. Application problems based on binomial distribution.
9. Application problems based on Poisson distribution.
10. Application problems based on negative binomial distribution.
11. Fitting of normal distribution when parameters are given.
12. Fitting of normal distribution when parameters are not given.
13. Problems based on Tests based on $\chi 2$, t and F distributions and Large Sample Tests.

And

Other practicals based on Core Courses 3.1, 3.2 and 3.3.

Skill Enhancement Course (SEC)

Course No. SOS/STAT/UG/SEC-3.01

Core Course - Credit 2

SEC 3.01: (Choose one)

1. Logic and Sets
2. Differential Calculus

SEC 3.01.1: Logic and Sets

Introduction, propositions, truth table, negation, conjunction and disjunction. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Sets, subsets, Set operations, the laws of set theory and Venn diagrams. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set.

Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.

Books Recommended

1. R.P. Grimaldi, Discrete Mathematics and Combinatorial Mathematics, Pearson Education, 1998.
2. P.R. Halmos, Naive Set Theory, Springer, 1974.
3. E. Kamke, Theory of Sets, Dover Publishers, 1950.

SEC 3.01.2: Differential Calculus

Limit, Continuity and Differentiability: Functions of one variable, Limit of a function (ε-δ Definition), Continuity of a function, Properties of continuous functions, Intermediate value theorem, Classification of Discontinuities, Differentiability of a function, Rolle's Theorem, Mean value theorems and their geometrical interpretations, Applications of mean value theorems.

Successive Differentiation, Expansions of functions and Indeterminate forms: Successive Differentiation, nth Differential coefficient of functions, Leibnitz Theorem; Taylor's Theorem, Maclaurin's Theorem, Taylor's and Maclaurin's series expansions.

References:

1. M. Ray: Differential Calculus.
2. H. S. Dhami: Differential Calculus.
3. T. M. Apostol: Calculus.
4. S. Lang: A First Course in Calculus.
5. Gorakh Prasad: Differential Calculus.

B.A./B.Sc. IVth Semester

Course No. SOS/STAT/UG/C-401

Core Course - Credit 4

Core 4.1: Analysis of Variance:

Introduction and Definition, Causes of Variation, Analysis of Variance. One way classification. Assumptions regarding model. Two way classification with equal number of observations per cell. Duncan's multiple comparison test. Analysis of covariance.

References:

1. Goon, Gupta and Das Gupta: Fundamentals of Statistics, Volume II.
2. Fundamentals of Applied Statistics: S C Gupta & V K Kapoor.
3. D.C. Montgomery, Designs and Analysis of Experiments.

Core 4.2: Statistical Inference:

Point Estimation: Introduction- Estimators and Estimate, Characteristics/Properties of Estimators- Unbiasedness, Consistency, Efficiency- Most Efficient Estimator, Minimum Variance Unbiased (MVU) Estimators, Sufficiency- Factorisation Theorem (Neyman), Invariance property of Sufficient Estimator, Fisher-Neyman Criterion for Sufficient Estimator, Methods of Estimation- Method of Maximum Likelihood Estimation, Properties of Maximum Likelihood Estimators, Method of Minimum Variance, Method of Moments, Method of Least Squares, Method of minimum Chi-Square.

Interval Estimation: Confidence Interval and Confidence limits- concept of best confidence intervals, Confidence Intervals for Large Samples.

Introduction, Statistical Hypothesis-Simple and Composite, Test of a Statistical Hypothesis, Null Hypothesis, Alternative Hypothesis, Critical Region, Two types of Error, Level of Significance, Power of the Test, Steps in Solving Testing of Hypothesis Problem, Optimum Test Under Different Situations- Most power test (MP Test), Uniformly Most Powerful Test (UMP Test), Neyman J. and Pearson, E.S. Lemma- Unbiased Test and Unbiased Critical Region, Optimum Regions and Sufficient Statistics, Likelihood Ratio Test- Properties of Likelihood Ratio Test.

References:

1. G. Casella and R.L. Berger, Statistical Inference.
2. E.J. Dudewicz and S.N. Mishra: Modern Mathematical Statistics.
3. J.D. Gibbons and S. Chakraborty, Non Parametric Statistical Inference.
4. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics.
5. M.G. Kendall and A. Stuart: The Advanced Theory of Statistics, Volume III.
6. R.V. Hogg, A.T. Craig and J.W. Mckean: Introduction to Mathematical Statistics.
7. V.K. Rohtagi and A.K. Md. E. Saleh: An Introduction to Probability and Statistics.

Core 4.3: Design of Experiments:

Principles of design of experiments-Replication Randomization and Local control and their importance in Design Theory, Completely randomized design- Layout, Statistical Analysis and Efficiency Comparisons with other designs, Randomized Block Design- Layout, Statistical Analysis and Efficiency Comparisons with other designs and Latin Square Design-Layout, Statistical Analysis and Efficiency Comparisons with other designs . Missing plot techniques-Analysis of Designs with missing Observations.

References:

1. Cochran and Cox: Experimental Design.
2. Kempthorne: Design of Experiments.
3. Federer: Experimental Designs.
4. Goon Gupta and Das Gupta: Fundamentals of Statistics, Volume II.

PRACTICAL/LAB WORK: Credit 2

List of Practical:

1. Analysis of variance in one-way and two-way classification (with and without interaction terms).
2. Unbiased estimators (including unbiased but absurd estimators)
3. Consistent estimators, efficient estimators and relative efficiency of estimators.
4. Cramer-Rao inequality and MVB estimators

5. Sufficient Estimators – Factorization Theorem, Rao-Blackwell theorem, Complete Sufficient estimators
6. Maximum Likelihood Estimation
7. Estimation by the method of moments, minimum Chi-square
8. Type I and Type II errors
9. Most powerful critical region (NP Lemma)
10. Uniformly most powerful critical region
11. Power curves
12. Likelihood ratio tests for simple null hypothesis against simple alternative hypothesis
13. Likelihood ratio tests for simple null hypothesis against composite alternative hypothesis
14. Analysis of a CRD
15. Analysis of an RBD
16. Analysis of an LSD
17. Analysis of an RBD with missing observation
18. Analysis of an LSD with missing observation

And

Other practicals based on Core Courses 4.1, 4.2 and 4.

Skill Enhancement Course (SEC)

Course No. SOS/STAT/UG/SEC-4.01

Credit 2

SEC 4.01: (Choose one)

1. Vector Differentiation and Vector Integration
2. Definite and Indefinite Integrals

SEC 4.01.1: Vector Differentiation and Vector Integration

Vector Differentiation: Ordinary differentiation of vectors, Applications to mechanics, Velocity and Acceleration, Differential operator-Del, Gradient, Divergence and Curl.

Vector Integration: Line, Surface and volume integrals, Simple applications of Gauss divergence theorem, Green's theorem and Stokes theorem (without proof).

References:

1. Murray R. Spiegel: Vector Analysis, Schaum's Outline Series.
2. N. Saran and S. N. Nigam: Introduction to vector.
3. Shanti Narayan: A text book of vector calculus.
4. P. N. Pandey: Polar Coordinate Geometry.
5. P. K. Jain and Khalil Ahmed: A textbook of Analytical Geometry.

SEC 4.01.2: Definite and Indefinite Integrals

Definite Integrals: Integral as a limit of sum, Properties of Definite integrals, Fundamental theorem of integral calculus, Summation of series by integration, Infinite integrals, Differentiation and integration under the integral sign.

Functions Defined by Infinite Integrals: Beta function, Properties and various forms, Gamma function, Recurrence formula and other relations, Relation between Beta and Gamma function, Evaluation of integrals using Beta and Gamma functions.

References:

1. M. Ray: Integral Calculus.
2. H. S. Dhami: Integral Calculus.
3. T. M. Apostol: Calculus.
4. S. Lang: A First Course in Calculus.
5. Gorakh Prasad: Integral Calculus.

B.A./B.Sc. Vth Semester

Skill Enhancement Course (SEC)

Course No. SOS/STAT/UG/SEC-5.01

Credit 2

SEC 5.01 (Choose one)

1. Algebra
2. Mathematical Methods

SEC 5.01.1: Algebra

Definition and examples of groups, examples of abelian and non-abelian groups, the group Zn of integers underaddition modulo n and the group U(n) of units under multiplication modulo n.

Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Lagrange's theorem, order of an element.

Definition and examples of rings, examples of commutative and non-commutative rings. Subrings and ideals,

References:

1. John B. Fraleigh: A First Course in Abstract Algebra.
2. M. Artin: Abstract Algebra.
3. Joseph A Gallian: Contemporary Abstract Algebra.
4. George E Andrews: Number Theory.

3. SEC 5.01.2: Mathematical Methods

Laplace Transforms: Definition, Existence theorem, Linearity property, Laplace transforms of elementary functions, Heaviside Step and Dirac Delta Functions, First Shifting Theorem, Second Shifting Theorem, Initial-Value Theorem, Final-Value Theorem, The Laplace Transform of derivatives, integrals and Periodic functions.

Fourier Transforms: Fourier Complex Transforms, Fourier sine and cosine transforms, Properties ofFourierTransforms, Inverse Fourier transforms.

References:

1. Murry R. Spiegal: Laplace Transform (SCHAUM Outline Series.
2. J. F. James: A student's guide to Fourier transforms.
3. Ronald N. Bracewell: The Fourier transforms and its applications.
4. J. H. Davis: Methods of Applied Mathematics with a MATLAB Overview.

B.A./B.Sc. Vth Semester

Discipline Specific Electives (DSE)

Course No. SOS/STAT/UG/DSE-5.01

Credit 4

DSE 5A. (Choose one)

1. Non Parametric Methods
2. Matrices

DSE 5A.1: Non Parametric Methods

Nonparametric tests: Introduction and comparison with Parametric Tests.

The Single-Sample Case- The Chi-Square Goodness-of-Fit Test, The Kolmogorov-Smirnov One-Sample Test, The One-Sample Runs Test for Randomness.

The Case of One Sample, Two Measures or Paired Replicates-The Sign Test, The Wilcoxon Signed Ranks Test.

Two Independent Samples-The Chi-Square Test for Two Independent Samples, The Median Test, The Wilcoxon-Mann-Whitney Test, The Kolmogorov-Smirnov Two-Sample Test.

References:

1. Mood, A.M., Graybill F and Boes D.C.: Introduction to the theory of Statistics.
2. Gibbons, J.D.: Non-parametric statistical inference.
3. Conover, W.J.: Practical Non-parametric Statistics.

DSE 5A.2: Matrices

Idempotent, nilpotent, involutary, orthogonal and unitary matrices, singular and nonsingular matrices, negative integral powers of a nonsingular matrix; Trace of a matrix.

Rank of a matrix, linear dependence of rows and columns of a matrix, row rank, column rank, equivalence of row rank and column rank, elementary transformations of a matrix and invariance of rank through elementary transformations, normal form of a matrix, elementary matrices, rank of the sum and product of two matrices, inverse of a non-singular matrix through elementary row transformations; equivalence of matrices.

Applications of Matrices:Solutions of a system of linear homogeneous equations, condition of consistency and nature of the general solution of a system of linear non-homogeneous equations, matrices of rotation and reflection.

References:

1. Hadley: Linear Algebra.
2. Hoffman and Kunz: Linear Algebra.
3. S. Lang: Linear Algebra.
4. K. B. Dutta: Matrix and Linear Algebra.
5. Shanti Narayan: Matrices.

DSE 5B. (Choose one)

1. Survey Sampling
2. Differential Equations

DSE 5B.1: Survey Sampling

Sampling vs. complete enumeration : sampling units and 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.

Stratified random sampling. Problem of allocation, proportional allocation, optimum allocation. Derivation of the expressions for the standard errors 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.

Systematic sampling: estimation of population mean and population total, standard errors of these estimators.

Regression and ratio methods of estimation in simple random sampling. Cluster sampling with equal and unequal clusters. Estimators of population mean and their mean square error. Double sampling in ratio method of estimation. Two-stage sampling with equal first stage units : estimator of population mean and its variance. Multi-stage sampling with examples (definition only). Non-sampling errors.

References:

1. Cochran, W.G.: Sampling Techniques.
2. Sukhatme, Sukhatme, Sukhatme & Asok: Sampling Theory of Surveys with applications.
3. Murthy, M. N.: Sampling theory.

DSE 5B.2: Differential Equations

First order exact differential equations. Integrating factors, rules to find an integrating factor. Basic theory of linear differential equations, Solving a differential equation by reducing its order. Linear homogenous equations with constant coefficients, Order and degree of partial differential equations, Linear partial differential equation of first order, Lagrange's method.

References:

1. Shepley L. Ross: Differential Equations.
2. I. Sneddon: Elements of Partial Differential Equations.

DSE 5C. (Choose one)

1. Operations Research
2. Queuing and Reliability Theory

DSE 5C.1: Operations Research

General linear programming problems and their formulations. Method for solving LPP: Graphical Method, Simplex method, Big – M method, Two phase Method, Duality in LPP 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. Introduction to Queueing Models Inventory Models.

References:

1. Swarup Kanti, Gupta P.K. and Man Mohan: Operations Research.
2. Taha, H.A.: Operations Research.

DSE 5C.2: Queuing and Reliability Theory

General concepts of queueing system, Measures of performance, Arrival and Service Processes, Single server and multi server models, channels in parallel with limited and unlimited queuesM/M/1/K. Application of simple queueing decision model's, Design and control models.

Basics of reliability. Classes of life distributions. Series, parallel, configurations. Reliability models, Reliability.

Concepts and definitions of preventive maintenance, corrective maintenance and age replacement.

References:

1. R.B. Cooper, Introduction to Queueing Theory.
2. D. Gross, C. M. Harris: Fundamentals of Queueing Theory.
3. U.N. Bhat: An Introduction to Queueing Theory: Modelling and Analysis in Applications (Statistics for Industry and Technology.
4. U.N. Prabhu: Foundations of Queueing Theory: International Series in Operations Research & Management Science.
5. John G. Rau: Optimization and Probability in Systems Engineering.
6. Riccardo Manzini, Alberto Regattieri, Hoang Pham, Emilio Ferrai: Maintenance for Industrial Systems.
7. P.K. Kapur, R.B. Garg, S. Kumar: Contributions to Hardware and Software Reliability.

PRACTICAL/LAB WORK: Credit 2

List of Practical:

Practicals based on Discipline Specific Electives (DSE).

B.A./B.Sc. VIth Semester

Skill Enhancement Course (SEC)

Course No. SOS/STAT/UG/SEC-6.01

Credit 2

SEC 6.01 (Choose one)

1. Introduction to Data Analysis
2. Multiple Integrals

SEC 6.01.1: Introduction to Data Analysis

Windows: Use of windows, its operations and applications.

MS word: operations of MS word and applications.

MS excel: Use of MS excel, its operations, solution of statistical problems using MS excel.

Introduction to SPSS and data types.

References:

1. Walter Rudin: Principle of Mathematical .
2. K. Knopp: Theory and Application of Infinite Series.
3. T. M. Apostol: Mathematical Analysis.

SEC 6.01.2: Multiple Integrals

Double integrals, Repeated integrals, Evaluation of Double integrals, Doubleintegral in polar coordinates, Change of variables and Introduction to Jacobians, Change of order of integration in Double integrals, Triple integrals, Evaluation of Triple integrals, Drichlet's theorem and its Liovelle's extension.

References:

1. M. Ray: Integral Calculus.
2. H. S. Dhami: Integral Calculus.
3. T. M. Apostol: Calculus.
4. S. Lang: A First Course in Calculus.

5. Gorakh Prasad: Integral Calculus.

B.A./B.Sc. VIth Semester

Discipline Specific Electives (DSE)

Course No. SOS/STAT/UG/DSE-6.01

Credit 4

DSE 6A. (Choose one)

1. Demography
2. Complex Analysis

DSE 6A.1: Demography

Demographic methods : 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. Graduation of mortality rates by Gompertz and Makeham formulae, logistic curve fitting and its use in population projection. Complete life table, its main features and construction.

References:

1. Basic Statistics relating to Indian Economy (CSO) 1990.
2. Statistical system in India (CSO) 1975.
3. Guide to Official Statistics (CSO) 1999.
4. Principles and accommodation of National Populations Census. UNESCO.

DSE 6A.2: Complex Analysis

Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Analytic functions, examples of analytic functions, CauchyGoursat theorem, Cauchy integral

formula.

Liouville's theorem and the fundamental theorem of algebra.

Laurent series and its examples, absolute and uniform convergence of power series.

References:

1. James Ward Brown and Ruel V. Churchill: Complex Variables and Applications.
2. Joseph Bak and Donald J. Newman: Complex analysis.

DSE 6B. (Choose one)

1. Applied Statistics
2. Linear Algebra

DSE 6B.1: Applied Statistics

Time series, its different components, illustrations, additive and multiplicative models, determination of trend, growth curves, analysis of seasonal fluctuations, construction of seasonal indices. Idea of Correlogram & periodogram.

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, Paashe's and Fisher's index number, time and factor reversal tests of index numbers, consumer price index

Introduction to Indian Official Statistical Systems, Development of Statistical System in India, Main statistical Units under Central Ministries- Ministry of Agriculture, Ministry of Industry, Ministry of Finance, Ministry of Labour, Ministry of Commerce, Ministry of Defence, Ministry of energy, Ministry of Planning, Ministry of Home Affairs. Organisation, role, functions and activities of central (CSO & NSSO etc) and state level organizations, Census Organisations: their setup and functions.

References:

1. Fundamentals of Applied Statistics: SC Gupta & VK Kapoor.
2. Fundamentals of Statistics: Volume II: Goon Gupta and Das Gupta.

DSE 6B.2: Linear Algebra

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension.

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation. Isomorphisms.

References:

1. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence: Linear Algebra.
2. David C. Lay: Linear Algebra and its Applications.
3. S. Lang: Introduction to Linear Algebra.
4. Gilbert Strang: Linear Algebra and its Applications.

DSE 6C. (Choose one)

1. Industrial Statistics
2. Regression Analysis

DSE 6C.1: Industrial Statistics

Statistical Quality Control, Process and Product Control, General Theory of Control Charts, Different Types of Control Charts for Variables and Attributes, Modified Control Charts. Sampling inspection by attributes- Single and Double sampling plans, producer's and consumer's risk, OC, ASN, AOQL and LTPD of sampling plans.

References:

1. Montgomery D.C. (1985): Introduction to Statistical Quality Control.
3. Burr: Industrial Quality Control.
4. Wetherill and Brown: Statistical Quality Control
6. Goon Gupta and Das Gupta: Fundamentals of Statistics, Volume II.
7. Siya Ram: Applied Statistics.

DSE 6C.3: Regression Analysis

Linear regression model of full rank, Least squares theory. Estimation of parameters- OLSE and MLE of β and test of hypotheses. R^2 and adjusted R^2. ANOVA table for regression.

References:

1. Johnston: Econometric Methods.

PRACTICAL/LAB WORK: Credit 2

List of Practical:

Practicals based on Discipline Specific Electives (DSE).