PONDICHERRY UNIVERSITY

(A CENTRAL UNIVERSITY)

B.Sc. STATISTICS

(CBCS)

REGULATIONS & SYLLABUS

2017-2018 ONWARDS

PREAMBLE

PONDICHERRY UNIVERSITY
B.Sc. DEGREE COURSE

REGULATIONS

(UG PROGRAMME IN B.Sc. (STATISTICS) DEGREE COURSE)

The revised syllabus shall be effective from the academic year 2017-2018 onwards.

DURATION OF THE COURSE

Prescribed Undergraduate studies in B.Sc., Statistics shall be of six consecutive semesters (three years). The maximum duration allowed for each student to acquire prescribed number of credits in order to complete the Programme of Study shall be twelve consecutive semesters (six years).

AGE LIMIT

The rules as applicable to other Under Graduate courses as prevailing in Pondicherry University.

ELIGIBILITY FOR ADMISSION

Students who have passed their Higher Secondary Examination under 10+2 system conducted by the Government of Tamil Nadu or any other equivalent system recognized by the Government of Puducherry based on the admission criteria laid down by Pondicherry University are eligible to apply to appropriate UG Programme of Study.

MEDIUM OF INSTRUCTION

The medium of instruction for all the courses, excepting Arabic, Bengali, French, Hindi, Malayalam, Sanskrit, Tamil, and Telugu, **shall be English**.

PATTERN OF EXAMINATION

- The End-Semester examination for each course in a Programme of Study shall be conducted by the Pondicherry University for a maximum of **75 marks** and Internal Continuous Assessment for **25 marks.**
- Internal assessment for all theory courses shall be done on the basis of at least two Internal Assessment tests (15 marks), term papers/assignments/seminars/case demonstrations/ presentations/ write-ups/viva etc. (5 marks) and attendance (5 marks). The following weightage shall be given to attendance:

  95% - 100% (5 marks)
  90% - 94% (4 marks)
  85% - 89% (3 marks)
  80% - 84% (2 marks)
  75% - 79% (1 mark)

- No student with less than 75% in any particular course shall be permitted to attend the end-semester examination and shall be given grade FA-failure due to lack of attendance. However, an overall condonation of 10% is permitted for valid reasons (NCC, NSS, Swach Bharat) or medical reasons. A student who has been awarded FA shall repeat the course when offered. The Principal/Head of the Department shall ensure that the candidate is informed about the lack of attendance before the commencement of end-semester examination and confirm that such candidates are not permitted to write the examination.
- To pass a course the student must secure minimum of 40 out of 100 marks (40%) in the internal and the end-semester examination put together.

SUPPLEMENTARY EXAMINATION

- A failed student who meets the attendance requirement may be permitted to register for the next end-semester examination in the following semester itself.
- Students who have failed due to insufficient attendance and /or less than 40% Internal Assessment marks should repeat the course as and when offered.

SCHEME OF EXTERNAL EXAMINATION
(Theory Paper)

Duration of exam - 3 hours
Total Marks: 75

- Examinations shall be in two sections.
- Section-A for 15 Marks and Section-B for 60 Marks(15+60=75).

SECTION – A: (5 x 3 = 15 Marks)

- It is of short answer type. Each question carry 3 marks.
- 10 questions to be given by setting 2 questions from each unit.
- Candidate should Answer 5 questions out of 10 questions.

SECTION – B: (5 x 12 = 60 Marks)

- It is of essay answer type. Each question carry 12 Marks.
- 5 questions to be given on internal choice (either or type). One question from each unit. Candidate should answer ALL questions.

SCHEME OF EXAMINATION (Practical Paper)

Duration of exam - 3 hours

INTERNAL EXAMINATION

Maximum Marks: 25

- Model Internal Examination by the course teacher: 20 Marks.
- Practical observation: 5 Marks.

EXTERNAL EXAMINATION

Maximum Marks: 75

- Six questions to be set.
- Candidates should answer any four questions.

Marks for practical: 60.

- Each question carry 15 Marks.
- The scheme of evaluation for 15 Marks:
  - for writing Aim: 2 Marks.
  - for writing formula and procedures: 4 Marks.
  - for making Calculations with excel: 6 Marks.
  - for writing interpretation/inference: 3 Marks.

Marks for record: 15

- **Record submission for practical paper is mandatory**

PONDICHERRY UNIVERSITY

B.Sc. DEGREE COURSE

SYLLABUS

(UG PROGRAMME IN B.Sc. (STATISTICS) DEGREE COURSE)

To be implemented from 2017-18 Onwards

COURSE	**SUBJECT CODE**	**TITLE OF THE PAPER**	**CREDITS ALLOTED**	
			Theory	**Tutorial/ Practical**
SEMESTER – I		**20 Credits**		
MIL-1	LBEN/LHIN/LMAL/LSAN/ LTAM/LTEL 111	Bengali/Hindi/Malayalam/ Sanskrit/Tamil/Telugu	03	
ENGLISH-1	ENGL 112	English – I	03	
DSC-1A	STAT 111	Basic Statistics	04	
DSC-2A	STAT 112	Mathematics for Statistics	04	
DSC-3A	STAT 113	Practical -1(using MS Excel based on the courses Stat-111)		04
AECC-1	PADM 113	Public Administration	02	`
SEMESTER – II		**20 Credits**		
MIL-2	LBEN/LHIN/LMAL/LSAN/ LTAM/LTEL 121	Bengali/Hindi/Malayalam/ Sanskrit/Tamil/Telugu	03	
ENGLISH-2	ENGL 122	English – II	03	
DSC-1B	STAT 121	Probability Theory	04	
DSC-2B	STAT 122	Distribution Theory	04	
DSC-3B	STAT 123	Practical -2 (using MS Excel based on the courses Stat-121, Stat-122)		04
AECC-2	ENVS 123	Environmental Studies	02	
SEMESTER – III		**20 Credits**		
MIL-3	LBEN/LHIN/LMAL/LSAN/ LTAM/LTEL 231	Bengali/Hindi/Malayalam/ Sanskrit/Tamil/Telugu	03	
ENGLISH-3	ENGL 232	English – III	03	
DSC-1C	STAT 231	Estimation Theory	04	
DSC-2C	STAT 232	Real Analysis	04	
DSC-3C	STAT 233	Practical -3 (using MS Excel based on the courses Stat-231)		04
SEC-1	STAT 234	Programming in C	02	
SEMESTER – IV		**20 Credits**		
MIL-4	LBEN/LHIN/LMAL/LSAN/ LTAM/LTEL 241	Bengali/Hindi/Malayalam/ Sanskrit/Tamil/Telugu	03	
ENGLISH-4	ENGL 242	English – IV	03	
DSC-1D	STAT 241	Testing of Hypotheses	04	
DSC-2D	STAT 242	Numerical Methods	04	
DSC-3D	STAT 243	Practical -4 (using MS Excel for STAT 241 & Programming in C for STAT-242)		04
SEC-2	STAT 244	Programming in C++	02	

COURSE	SUBJECT CODE	TITLE OF THE PAPER	CREDITS ALLOTED	
			Theory	Tutorial/ Practical
SEMESTER – V		**20 Credits**		
SEC-3	STAT 351	Data Analysis using SPSS	02	
*DSE-1A *DSE-2A *DSE-3A	STAT 352	Operations Research	04	01
	STAT 353	Stochastic Processes	04	01
	STAT 354	Applied Statistics	04	01
	STAT 355	Sampling Methods	04	01
GE-1	STAT 356	Industrial Statistics	03	
SEMESTER – VI		**20 Credits**		
SEC-4	STAT 361	Statistics using R	02	
*DSE-1B *DSE-2B *DSE-3B	STAT 362	Statistical Quality Control	04	01
	STAT 363	Regression Analysis	04	01
	STAT 364	Design of Experiments	04	01
	STAT 365	Project Work	06	
GE-2	STAT 366	Data Base Management Systems	03	

- **Total Number of Credits 120**
- *Any three papers can be selected from the pool of papers for DSE-1A, 2A, and 3A in the fifth semester and any three papers can be selected from the pool of papers for DSE-1B, 2B and 3B in the sixth semester, respectively.

Distribution of Credits

Course	No. of Credits	
DSC	48	Discipline Specific Course
AECC	04	Ability Enhancement Compulsory Course
MIL	12	Multiple Indian Languages
ENGLISH	12	English
SEC	08	Skill Enhancement Course (Open to students of all Departments)
DSE	30	Discipline Specific Elective
GE	06	Generic Elective (Open to students of all Departments)
Total	**120**	

Detailed and course wise Syllabus for B.Sc. Statistics

SEMESTER – I **4 Credits**

DSC-1A

STAT-111:BASIC STATISTICS

UNIT 1

Introduction to Statistics – Primary and Secondary data – Nominal, Ordinal, Ratio, and Interval scale (with examples) - Graphical Representation of data – Bar-charts, Pie-diagrams, Histograms, Frequency polygon, Ogives.

UNIT 2

Measures of central tendency – properties – merits and demerits – weighted means – graphical location of median, quartiles, deciles, percentiles, and mode – relation between arithmetic mean, geometric mean and harmonic mean.

UNIT 3

Measures of dispersion – characteristics – Coefficient of dispersion – Coefficient of variation – Moments – Relation between moments about mean in terms of moments about point – Pearson's β and γ coefficients.

UNIT 4

Skewness and Kurtosis – Pearson's coefficient of skewness – Bowley's coefficient of skewness – coefficient of skewness based upon moments – Curve fitting – Principle of least squares – Fitting of straight line, parabola, exponential and power curve.

UNIT 5

Simple correlation – Karl Pearson's coefficient. of correlation – Rank correlation – Simple Regression – lines of regression – properties of regression coefficient – Multiple and Partial correlation coefficient in three variables.

Books for Study:

1. Agarwal.B.L(1996): Basic Statistics, 3/e, New Age International (P) Ltd.,.
2. S.P.Gupta (2014), Statistical Methods, Sultan Chand & sons
3. Gupta,S.C. and Kapoor, V.K.(2000): Fundamentals of Mathematical Statistics, 10/e, Sultan Chand and Sons.

Books for Reference:

1. Sanjay Arora &Bansilal (2002): New Mathematical statistics, Meerat Publications, New Delhi
2. Hooda.R.P.(2003): Statistics for Business and Economics, 3/e, Mac Millan.

Note to the paper setter : 100% Theory

SEMESTER – I **4 Credits**

DSC-2A

STAT 112: MATHEMATICS FOR STATISTICS

UNIT I

Matrices: Elementary, scalar, Hermitian, skew-Hermitian, symmetric, skew-symmetric, Unitary, triangular, equivalent and similar matrices- Transpose and conjugate of a matrix – Rank of a matrix

UNIT II

System of Linear Equations- Consistency-Different types of solutions – Inverse of a Matrix. Characteristics Equation – Eigen values and Vectors –Cayley Hamilton Theorem.

UNIT III

Successive Differentiation – Leibnitz Theorem – Partial differentiation – Maxima and Minima of functions of two variables

UNIT IV

Integration – Properties of Definite Integrals – Reduction formula – Bernoulli's formula

UNIT V

Double and Triple Integrals – Evaluation in simple cases only – Use of Jacobian transformation- Definitions of Beta and Gamma Integrals – Recurrence Formula for Gamma Integral Properties of Beta Integral– Application of Beta Gamma Integrals – Relation between Beta and Gamma Integrals.

Books for Study:

1. M.K. Venkataraman: Engineering Mathematics, National Publishing Company, Chennai.
2. T.K. Manicavachagom Pillay, T. Natarajan, K.S. Gnanapathy, Algebra, Volume II,
   S. Viswanathan (Printers & Publishers) Pvt.Ltd., Chennai.
3. T.K. Manicavachagom Pillay, T. Natarajan, K.S. Gnanapathy, Calculus, Vol **I, II & III**, S. Viswanathan (Printers & Publishers) Pvt.Ltd., Chennai.

SEMESTER – I **4 Credits**

DSC-3A

STAT-113: PRACTICAL -1

(using MS Excel based on the courses Stat-111)

1. Diagrammatic Representation Bar Chart, Pie Diagram
2. Construction of Discrete and Continuous Frequency Tables from raw data
3. Graphical Representation - Histogram
4. Summary Statistics
5. Two way tables and plots
6. Simple correlation, Rank correlation
7. Partial and multiple correlation
8. Fitting of straight line, second degree
9. Fitting of exponential and power curves

SEMESTER – II **4 Credits**

DSC-1B

STAT-121: PROBABILITY THEORY

UNIT 1

Introduction to probability theory – Random experiments, Events, Sample space, Algebra of events, Operations on events – Classical approach to probability – Axiomatic approach to probability – Simple problems.

UNIT 2

Addition theorem - Conditional Probability – Independence of events – Multiplication theorem – Bayes theorem and its applications.

UNIT 3

Random variables – Discrete and Continuous Random Variable – Probability Mass function and Probability Density function – Distribution function – Properties.

UNIT 4

Mathematical Expectation of random variables and its properties - Moment generating function– Cumulant generating function – Characteristic function – Definition - their properties for discrete and continuous variates – Simple problems.

UNIT 5

Bivariate distributions – Discrete and Continuous type - Joint Density Function - Marginal distribution functions – Conditional distribution function and conditional density function – Marginal and Conditional Expectation.

Books for Study:

1. Hogg, R.V., Mc Kean J W and Craig, A.T. (2005): Introduction to Mathematical Statistics, 6/e, Pearson Edition.
2. Gupta,S.C. and Kapoor, V.K.(2000): Fundamentals of Mathematical Statistics, 10/e, Sultan Chand and Sons.
3. A. M. Mood, F. A. Graybill, D. C. Boes (2002), Introductory to the Theory of Statistics, 3/e, Mc Graw hill

Books for Reference:

1. Bansilal and sanjayArora (2002): New Mathematical Statistics, Satyaprakashan Publications, New Delhi.
2. Rohatgi V.K. and Md. EhsanesSaleh A.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication.
3. Bhat B.R, Srivenkataramana T and RaoMadhavaK.S(1996): Statistics: A Beginner's Text, Vol.II, Nw Age International(P) Ltd.
4. Murray R. Spiegel, John J. Schiller, R. Alu Srinivasan (2013), Schaum's Outline of Probability and Statistics, Fourth Edition, The McGraw-Hill Companies, Inc.

Note to the paper setter : 100% Theory

SEMESTER – II **4 Credits**

DSC-2B

STAT-122: DISTRIBUTION THEORY

UNIT 1

Discrete Distributions – Uniform, Bernoulli, Binomial, Poisson, Negative Binomial, Geometric, Hypergeometric distribution and their characteristics – Simple problems (Mean and Variance).

UNIT 2

Continuous distribution - Uniform, Exponential, Gamma, Beta, Cauchy, Pareto Distributions – Characteristics Properties of these distribution – Simple problems

UNIT 3

Normal, Lognormal distributions and their characteristics properties - Bivariate Normal distribution – Marginal and conditional distribution – Simple problems.

UNIT 4

Sampling Distribution – t, F and Chi-square – derivation of their probability density functions – relation among t, F and chi-square distribution- characteristic properties of t, F and chi-square

UNIT 5

Order Statistics – Distribution of first, n^{th} and arbitrary order statistics – joint distribution of r^{th} and s^{th} order statistics – distribution of range and median – simple problems.

Books for Study:

1. Hogg R.V. and Craig A.T.(1998): Introduction to Mathematical Statistics, 4^{th} edition, Collier Macmillan Press.
2. Bhat B.R, Srivenkataramana T and RaoMadhava K.S.(1996): Statistics: A Beginner's Text, Vol. II, New Age International(P) Ltd.
3. Mood A.M., Graybill F.A and Boes D.C. (2002): Introduction to the TheoryofStatistics, McGraw Hill.

Books for Reference:

1. Gupta, S. C and Kapoor, V.K (2010), Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
2. Murray R. Spiegel, John J. Schiller, R. Alu Srinivasan (2013), Schaum's Outline of Probability and Statistics, Fourth Edition, The McGraw-Hill Companies, Inc.
3. Rohatgi V.K. and Md. EhsanesSaleh A.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication

Note to the paper setter : 100% Theory

SEMESTER – II **4 Credits**

DSC-3B

STAT-123: PRACTICAL -2

(using MS Excel based on the courses Stat-121& Stat-122)

1. Create a sample space, obtain random variables and also arrive to probability distributions in the case of (i) 4 coin tossing problem (ii)2 dice throwing problem (iii) 2 dice and 2 coin tossing problem
2. Problem based on inverse probability/ Bayes theorem
3. Computation of moments for discrete and Continuous Probability distribution function
4. Probability on joint, conditional and marginal distributions
4. Computation of probabilities of Binomial, Poisson and Normal Distribution
5. Discrete Distributions with simple problems
    1. Binomial Distribution
    2. Poisson Distribution
    3. Geometric Distribution
    4. Negative Binomial Distribution
    5. Normal Distribution
6. Continuous Distributions with simple problems
    a. Uniform Distribution
    2. Exponential Distribution
    3. Normal Distribution
    4. Bivariate Normal Distribution

SEMESTER – III **4 Credits**

DSC-1C

STAT 231 :ESTIMATION THEORY

UNIT 1

Point estimation – Properties of estimators – Unbiasedness –Consistent estimators - Properties of consistent estimators – sufficient condition for consistency – Simple problems.

UNIT 2

Concept of efficiency – Minimum Variance Unbiased Estimator (MVUE) – Uniqueness of MVUE – Cramer-Rao inequality - Simple Problems – Concept of Sufficient statistics with illustration – Neyman Factorization theorem discrete case with proof - Rao-Blackwell theorem - Simple problems.

UNIT 3

Methods of moments – Method of Maximum Likelihood (M.L.E.) – Properties of Maximum Likelihood Estimators (without proof) –Simple Problems

UNIT 4

Method of Least Squares – Method of Minimum Chi-square - Simple problems.

UNIT 5

Interval Estimation - Concepts of Confidence Interval and Confidence Coefficient - Confidence Intervals for mean, difference of means, Proportions (single and difference), ratio of variances of the parameters of univariate normal, two independent normal and one parameter exponential distribution – Large sample confidence interval.

Books For Study:

1. Hogg R.V. and Craig A.T.(1998): Introduction to Mathematical Statistics, 4th edition, Collier Macmillan Press.
2. Mood A.M., Graybill F.A and Boes D.C. (1974): Introduction to the TheoryofStatistics, McGraw Hill.
3. Rohatgi V.K. and Md. EhsanesSaleh A.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication.

Books for Reference:

1. Gupta, S. C and Kapoor, V.K (2010), Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
2. Kale, B.K, Muralidharan, K, (2015), Parametric Inference: An introduction, Alpha Science International Ltd
3. Srivastava, Manoj Kumar , Khan, Abdul Hamid , Srivastava, Namita, (2014), Statistical Inference: Theory Of Estimation, PHI Learning Private Limited.

Note to the paper setter : 100% Theory

SEMESTER – III **4 Credits**

DSC-2C

STAT 232: REAL ANALYSIS

UNIT 1
Sequence of real numbers : Limit of a sequence - Convergent sequences, Divergent sequences - Bounded sequences - Monotone sequences – Cauchy's first and second theorem on limits – Cauchy's general principle of convergence

UNIT 2
Series of real numbers : Convergence and divergence - series with non-negative terms – comparison test – p-test, D'Alembert's ratio test, Cauchy's Root test - Alternating series - Conditional convergence and absolute convergence – Leibnitz test.

UNIT 3
Functions : Limit of real valued function in one variable, continuity – types of discontinuities – algebra of continuous functions – Extreme value theorem – Intermediate value theorem – Uniformly Continuous functions

UNIT 4
Increasing and Decreasing functions – Differentiability – Darboux'sTheorm – Rolle's Theorem – Mean value theorem for derivatives – Taylor's Series expansion

UNIT 5
Riemann Integration – Definition and existence of the integral – refinement of partitions – Darboux's theorem – Conditions of Integrability – Integrability of sum and modulus of integrable functions – Integration and Differentiation – Fundamental Theorem of Calculus

Books for Study:

1. Malik S.C. and SavitaArora (2010): Mathematical Analysis, 4/e, New Age International Publishers
2. D. Somasundaram and B. Choudhary (2002) : A first course in Mathematical Analysis, Narosa Publishing house
3. R. R. Goldberg (1970) : Methods of Real Analysis, Oxford & IBH.

Books for Reference :

1. T. M. Apostol(1985): Mathematical Analysis, Narosa Publishing House.
2. W. Rudin(1976): Principles of Mathematical Analysis, 3/e, McGraw Hill Company.

SEMESTER – III **4 Credits**

DSC-3C

STAT 233 :PRACTICAL -3

(using MS Excel based on the courses STAT-231)

1. Estimation of the parameters of the discrete and continuous distribution by the method of moments and method of maximum likelihood.

2. Confidence Intervals for the parameters (means, variances and proportions) of Normal distribution.

SEMESTER – III **2 Credits**

SEC-1

STAT 234 :PROGRAMMING IN C

UNIT 1

Introduction – C character set, Identifiers and keywords. Data Type, Declarations, Expressions, statements and symbolic constants, Input-Output: getchar, putchar, scanf, printf, gets, puts, functions, pre-processor commands, #include, define preparing and running a complete C program.

UNIT 2

Operators and expressions: Arithmetic, Unary, Logical, bit-wise, assignments and conditional Operator, Library functions.

UNIT 3

Control statements: while, do-while statement, nested loops, if-else, nested if-else, switch, break, continue and goto statements, comma operator.

UNIT 4

Arrays: declaration of one and two dimensional arrays –Strings and operations on strings, String Library functions.

UNIT 5

Functions: Defining and accessing: Passing arguments, Call by reference, Call by Value, Function Prototypes, Recursion. Use of library functions.Structures, Array of Structures

Books for Study:

1. B. S. Gottfried (1998): Programming in C, Schaum's Outline series.
2. E. Balagurusamy: Programming in ANSI C, Tata McGraw Hill. Schildt Herbert: C Made Easy, McGraw Hill.

Books for Reference:

1. Kernighan and D. Ritchie (1988): The C programming Language, Prentice Hall of India.
2. Yeshwant Singh Kanitkar (1993): Exploring C, BPB Publications.

Questions on programs shall be on computing mean, median, correlations etc.,

SEMESTER – IV **4 Credits**

DSC-1D

STAT 241: TESTING OF HYPOTHESES

UNIT 1

Statistical Hypothesis – Simple and composite hypothesis, Null and Alternative Hypothesis – Two types of errors – Critical region – p-value – Power of test – Most powerful test – Neymann Pearson Lemma – Simple problems.

UNIT 2

Uniformly most powerful tests – definition and simple applications – Likelihood Ratio tests – Definition and simple applications.

UNIT 3

Test of significance: Exact and Asymptotic test based on Normal, Student's t, Chi-square and F-distributions for testing the means, proportions, variances and correlation coefficient – Chi-square test of independence.

UNIT 4

Sequential tests – Need for sequential tests – Wald's SPRT with illustrations – Approximate OC and ASN functions for tests regarding parameters of binomial and normal distributions.

UNIT 5

Non-parametric methods: Sign test – Wilcoxon Signed rank test- Mann Whitney U test - Median test - Run test – Kolmogrov-Smirnov test – Kruskal Wallis test.

Books For Study:

1. Hogg R V and Craig A T(1998): Introduction to Mathematical Statistics, McGraw Hill Publishing Co., New York.
2. Hogg R.V. and Tanis E.A.(2001) : Probability and Statistical Inference, Pearson Education Asia.
3. Rohatgi V.K. and Md. EhsanesSaleh A.K.(2001): An Introduction to Probability and Statistics, Second Edition, John Wiley Publication.

Books for Reference:

1. Freund J.E. (2000): Mathematical Statistics, Prentice Hall of India.
2. Rao C.R. (1973): Linear Statistical Inference and Its Application, Revised Edition, Wiley Eastern.
3. Goon A.M, Gupta M.K., Das Gupta B. (1980): An Outline of Statistical Theory, Vol. 2, 6th revised edition, World Press, Calcutta.
4. Mood A M, Graybill F A and Boes D C(1974): Introduction to Theory of Statistics, McGraw Hill Publishing Co., New York

Note to the paper setter : 100% Theory

SEMESTER – IV **4 Credits**

DSC-2D

STAT 242: NUMERICAL METHODS

UNIT 1

Solution of Algebraic and Transcendental Equations**:** Bisection method – Regula Falsi method – Iteration method - Newton Raphson method – Horner's Method Simultaneous equations: Direct methods; Gauss Elimination method – Gauss-Jordan method – Iterative methods: Gauss-Jacobi method - Gauss Siedal iterative method.

UNIT 2

Finite differences: Forward and backward differences – Differences of a polynomial – Relation between the Operators E, Δ, δ, μ and backward difference operator, and their basic properties – Application to summation of series.

UNIT 3

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

UNIT 4

Inverse interpolation: Iteration or successive approximation method – Lagrange's method — simple problems. Numerical Integration: Trapezoidal rule – Simpson's 1/3 and 3/8 rules – Weddle's rule – Euler's summation formula

UNIT 5

Difference equation: Introduction - Definitions - Formation of difference equations- Linear difference equations – Rules for finding the complementary function – Rules for finding the particular integral – Difference equations reducible to linear form – Simultaneous difference equations with constant coefficients.

Books for Study:

1. S.S.Sastry (1998): Introductory Methods of Numerical Analysis, Prentice-Hall of India.
2. B. S. Grewal(1997): Numerical Methods in Engineering and Science, Khanna Publishers, India
3. M. K. Venkatraman: Numerical Methods in Engineering and Science, National Publishing company, India

Books for Reference:

1. Scarborough B: Numerical Mathematical Analysis, OUP.

SEMESTER – IV **4 Credits**

DSC-3D

STAT 243: PRACTICAL -4

(using MS Excelfor Stat-241& Programming in Cfor Stat-242)

Practical programs using MS Excel (STAT 242)

1. Large Sample Tests: Means, Variances and Proportions

2. Test based on Chi-square statistic: Population variance, testing the goodness of fit

3. Test based on t statistic: Single men, Difference of means, Paired t test, Correlation coefficient, Regression coefficient.

4. Test based on F statistic: Equality of two population variance

5. Non-parametric tests – Sign test, Wilcoxon test, Mann-Whitney U test, Median test, Run test, Kolmogorov –Smirnov one sample test, Kruskal Wallis test.

Practical programs using C (STAT 242)

6. Find the root using Bisection method
7. Find the root using Newton Rapson Method
8. To find the solution of simultaneous equation using gauss siedal iterative method
9. To interpolate the given data using Lagrange's Interpolation formula
10. Evaluate the definite integral using Simpson1/3rd and 3/8thRule
11. Evaluate the definite integral using trapezoidal rule

SEMESTER – IV **2 Credits**

SEC-2

STAT 244: PROGRAMMING IN C++

UNIT 1

Introduction to Object Oriented Programming (OOP), C++ programming basics, Tokens, Keywords and control statements: Identifiers- data types - basic, user-defined and derived data types- symbolic constants -variable declaration operators in C++, Scope resolution operator - manipulations - cost operators - operator over loading and precedence - control structures.

UNIT 2

Functions: Simple functions, passing argument to functions, returning values from functions, reference arguments, overloaded functions, inline functions, variable and storage classes.

UNIT 3

Classes and Objects: Class specification - member function - nesting and private member functions - array of objects - returning objects - constant member functions - Constructors and Destructors : default arguments - copy and dynamic constructors – destructors.

UNIT 4

Inheritance: Defining derived classes - single inheritance - multilevel and multiple inheritance - hierarchical and hybrid inheritance.

UNIT 5

Input/Outputoperators : console I/O -streams - stream classes - unformatted and formatted I/O - Files : Classes for files - opening and closing files - file modes - sequential I/O - updating files

Books for Study

1. E. Balaguruswamy (1998): Object Oriented Programming with C++, Tata McGraw- Hill, New Delhi.
2. Robert Lafore(1994): Object Oriented Programming in Turbo C++, Galgotia Publication Pvt. Ltd.

Books for Reference

1. R. Venugopal: Mastering C++, Tata Mcgraw_Hill.
2. John Huddard (1996) Programming with C++, Schaum's Series, McGraw-Hill.

SEMESTER – V **2 Credits**

SEC-3

STAT 351: DATA ANALYSIS USING SPSS

UNIT 1

Basic of SPSS – Importing and Exporting of files – Recoding and Computing new variables.Selection of cases – splitting and merging of files

UNIT 2

Graphical plots: Box Plot, Scatter plot, Histogram, Bar and Pie charts, Frequencies, Custom tables, Cross Tabulations.

UNIT 3

Fitting of Curves: Parabola, cubic and exponential – correlation and regression: simple, multiple – Rank correlation –Multiple Regression.

UNIT 4

Testing of Hypotheses – one sample, two sample and paired samples t – test; F-test for two sample variances;Chi-square test for independence of attributes.NP: Sign Test, Mann-Whitney U test, Wilcoxon-Sign rank test

UNIT 5

One way and Two Way Analysis of Variance,2^2,2^3,3^2factorial designs

Books for Study

1. Ajai S. Gaur and Sanjaya S Gaur (2009), **Statistical Methods for Practice and Research -** A Guide to Data Analysis Using SPSS, Second Edition, SAGE Publications Pvt. Ltd
2. Robert Ho (2006), Handbook of Univariate and Multivariate Data Analysis and Interpretation with SPSS, Chapman and Hall, CRC Press
3. Sarma KVS (2010), Statistics Made Simple – Do It Yourself on PC, Second Edition, PHI Learning

Books for Reference

1. William E Wagner, III (2010), Using IBM® SPSS® Statistics for Social Statistics and Research Methods, Third Edition, PINE FORGE PRESS, An Imprint of SAGE
2. Sabina Landau and Brian S. Everitt (2004), A Hand book of Statistical Analysis using SPSS, Chapman and Hall, CRC Press
3. Andy Field (2009), Discovering Statistics Using SPSS (Introducing Statistical Methods Series), Third Edition, SAGE Publications Ltd.

SEMESTER – V **4 Credits**

DSE-1A

STAT 352: OPERATIONS RESEARCH

UNIT 1

Introduction to Operations Research – Principal Components of Decision problem – Phases of Operations Research study.

UNIT 2

Linear Programming – Graphical Solution – Simplex method including artificial variable technique- Big M-Method and two-Phase methods – Principle of Duality

UNIT 3

Transportation Problem: Initial Basic Solution by North West Corner Rule, Least Cost and Vogel's Approximation Methods – Optimal solution by Modified Distribution (MODI) Method – assignment problem – Simple problems

UNIT 4

Sequencing – 'n' jobs and 2 machine problem – 'n' jobs and 'm' machine problems – 2 jobs and 'm' machine problem – Game Theory – Optimal solution of two person zero sum games – mixed strategies – Graphical Solution of (2 x n) games – solution of (m x n) games by linear programming – dominance property.

UNIT 5

Network analysis by CPM / PERT: basic Concepts: Constructions of the network – Concepts of Slack and float in network analysis - Determination of the floats and critical path.

Books for study:

1. Hamdy.A.Taha(1999): Operations Research, 6th Edition, Macmillan Publishing Co. Inc.
2. KantiSwarup et al.: Opertaions Research, Sultan Chand and Sons, New Delhi.
3. Goel and Mittal (1982): Operations Research, PragatiPrakashan, Meerut.

Books for Reference:

1. Hiller F.S. and Libermann G.J.: Introduction to Operations Research, McGraw Hill.
2. Sharma J.K.(2001): Operations Research: Theory and Applications, Macmillan India Ltd.

Note to the paper setter : 20% Theory and 80% Problems

SEMESTER – V **4 Credits**

DSE-2A

STAT 353: STOCHASTIC PROCESSES

UNIT 1

Definition of stochastic process - classification of stochastic processes according to time parameter and state space – examples of stochastic processes – definition of stationary process – stationary process with independent increments.

UNIT 2

Markov chains : Definition and examples of Markov chain, Transition Probability Matrix, Higher Transition Probabilities: Chapman-kolmogorov equation, Random walk – orientation with numerical problems simple problems.

UNIT 3

Classification of states of Markov chain, Basic limit theorem of Markov chain (statement only), stationary and limiting distribution for a Markov Chain – Existence of limiting distribution.

UNIT 4

Poisson Processes – Postulates and its distribution – properties of Poisson Process: Addition and difference of Poisson Process and its connection with Binomial and Exponential distribution – Birth and Death Process (Concept only) – Yule-Furry process.

UNIT 5

Characteristics of queuing models - Busy period– Simple queuing models M/M/1– Simple problems

Books for Study

1. Medhi, J. (1996): Stochastic processes, New Age International (p) Ltd.

Books for Study and Reference:

1. Karlin, S. and Taylor, H.M. (1975): A first course in Stochastic processes, Academic press.
2. Adke, S.R. and Manjunath, S.M. (1984): An introduction to Finite Markov Processes,Wiley Eastern.
3. Ross, S.M. (1983): Stochastic processes, John Wiley.

Note to the paper setter : 100% Theory

SEMESTER – V **4 Credits**

DSE-3A

STAT-354: **APPLIED STATISTICS**

UNIT 1

Concept of time series, components of time series – Mathematical Models - Additive and Multiplicative models, uses of time series –- Measurement of trend by graphical method, Method of semi averages, least square method and methods of moving averages.

UNIT 2

Seasonal indices – Simple average, Ratio to moving average – Ratio to trend and link relative method – Cyclic fluctuations – residual method only – Variate difference method.

UNIT 3

Definition of Index numbers – Weighted and unweighted index numbers – Laspeyre's, Paasche's, Fisher's, Marshall – Edeworth index number – optimum tests for index numbers, fixed and chain base index numbers – cost of living number – construction and uses

UNIT 4

Measures of mortality – Crude mortality rate – specific Death rate – Infant mortality rate – Neonatal mortality rate – Foetal death rate – maternal mortality rate – Direct and indirect standardization of death rates – complete life table – structure – interrelationship among life table functions – uses of life table.

UNIT 5

Measure of fertility – Crude Birth Rate (CBR) – General and specific fertility rates – General marital fertility rate – Age specific fertility rate – Total fertility rate – Gross reproduction rate – Net reproduction rate – cohort fertility analysis – measures of migration – crude, specific and standardized rates – survival ratio and national growth rate method.

Books for Study:

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. Mukhopadhyay P. (1999): Applied Statistics, New Central Book Agency Pvt. Ltd., Calcutta.

Note to the paper setter : 60% Theory and 40% Problems

SEMESTER – V **4 Credits**

DSE-4A

STAT 355: SAMPLINGTHEORY

UNIT 1

Concept of sampling – Need for sampling – Population and sample – sampling unit and sample frame – types of population – basic properties of population – sample survey and census – Principal steps in a Sample Survey – Notion of sampling error.

UNIT 2

Simple random sampling with and without replacement –Estimation of Population mean and proportion and their variances

UNIT 3

Stratified sampling – Principles of stratification – estimation of population mean and its variance – allocation techniques – estimation of gain due to stratification - Determination of sample size.

UNIT 4

Systematic Sampling – Estimation of population mean and its sampling variance – comparison of systematic, simple random and stratified random sampling

UNIT 5

Cluster sampling with equal sized clusters – estimation of population mean and variance.

Books for study:

1. W.G.Cochran(1999), Sampling Techniques, 3rd Edition, Wiley Eastern Ltd.
2. Daroga Singh and F.S.Choudhary(1986), Theory and analysis of Sample Survey Designs, Wiley Eastern Ltd.
3. S.C. Gupta and V.K.Kapoor(2001), Fundamentals of Applied Statistics, Sultan Chand and Sons.

Books for Reference:

1. Pandurang.V.Sukhatme and Balkrishna.V.Sukhatme(1970): Sampling Theory of Survey with application, Asia Publication House.
2. ParimalMukhopadhyay: Theory of Sample Surveys, Prentice Hall of India

Note to the paper setter : 80% Theory and 20% Problems

SEMESTER – V **3 Credits**

GE-1

STAT 356: INDUSTRIAL STATISTICS

UNIT 1
Inventory planning: Concept of planned inventory policies Deterministic modelsPolicy when inventory levels are reviewed continuously and demands occuruniformly with and without shortage costs Economic order quantity.

UNIT 2
Policy for production planning when inventory levels are reviewed periodicallyStochastic models Single period model with no set up cost having zero or nonzeroinitial stock {(s,S) policy} Solving special cases using computer packages.

UNIT 3
Forecasting: Concept of forecasting and its applications in manufacturing andnonmanufacturing industrial situations Different methods of forecasting including average, last value, weighted average(exponential smoothing Forecasting in presence of linear trends using least square methods Forecastingin presence of seasonal effects Solving special cases using computer package.

UNIT 4
Reliability: Definitions and relationships between survival function, hazad,function, hazard rate of a non-negative random variable parametricdistributions: Weibull, Gamma, Lognormal and Exponential as life timedistributions - Concept of aging, IFR, FRA classes of distributions and theirdual.

UNIT 5
Coherent system as binary function: Minimal cut and path sets(vectors)Representation of structure function of series, parallel and t out of n : Gsystems of independent components Minimal cut and path structure functionsDual of a coherent structure Derivation of reliabilities of above structures.

Books for study:

1. Taha H A (7999): operations Research, Macmilan publishing co.
2. Hiller F S and Libermann G J(1995): Introduction to Operations Research, 6tr, Edition. McGraw Hill.
3. Bain L J and Enghardt(1991): Statistical Analysis of Reliability and LifeTesting Models, Marckel Dekker.

Books for Reference:

1. Zacks S (1992): Introduction to Reliability Analysis, Probability models and Statistical methods, Springer Verlag.
2. Barlow R E and Proschan F(1975): Statistical theory of Reliability and Lifetesting :Probability models, Holt, Rinehart and Winston.

SEMESTER – VI **2 Credits**

SEC-4

STAT 361: STATISTICS USING R

UNIT 1

Introduction to R: R as a calculator, statistical software and a programming language,R preliminaries, getting help, data inputting methods (direct and importing from other spread Sheet applications like Excel), data accessing, and indexing, Graphics in R, built in functions, saving, storing and retrieving work.

UNIT 2

Descriptive statistics: diagrammatic representation of univariate and bivariate data, measures of central tendency, partition values, measures of dispersion, summaries of a numerical data, skewness and kurtosis, random sampling with and without replacement.

UNIT 3

Probability Distributions: R as a set of statistical tables- cumulative distribution, probability density function, quantile function, and simulate from the distribution, plotting probability curves for standard distributions.

UNIT 4

Statistical Inference: One- and two-sample tests, *z*-test, t-test, F-test, chi-square test of independence and goodness of fit, interval estimation for mean, difference of mean and variance, tests for normality.

UNIT 5

Analysis of Variance – correlation – Simple and Multiple regressions

Books for Study

1. Dr.Mark Gardener, Beginning R The statistical Programming Languages, John Wiley & Sons (2012).

2. Sudha G. Purohit, SharadD.Gore, and ShailajaR.Deshmukh, Statistics Using R, Narosa Publishing House, India(2008)

Books for References:

1. Michale J. Crawley, THE R BOOK, John Wiley & Sons, England (2009)

2. John Verzani, simple R-Using R for Introductory Statistics,

(http://www.math.csi.cuny.edu/Statistics/R/SimpleR/Simple)

3. W. N. Venables, D. M. Smith and the R Core Team, An Introduction to R, Notes on R: AProgramming Environment for Data Analysis and Graphics, Version 2.15.2 (2012)

SEMESTER – VI **4 Credits (Theory) & 1Credit (Tutorial)**

DSE-1B

STAT 362: STATISTICAL QUALITY CONTROL

UNIT 1

Concept of Quality – Quality movement in India – Standardization for Quality – Quality movement – Quality management – Quality circles

UNIT 2

Need for SQC in industries – process control – chance and assignable causes of variations – concepts of specification and tolerance limits – process capability – statistical basis for control charts –

UNIT 3

Control chart for variables – X bar and R chart - their construction and analysis.

Control charts for attributes – p, np, c and U charts – their construction and analysis.

UNIT 4

Product control – fundamental concepts of acceptance sampling by attributes – producer's and consumer's risk – concepts of AQL, LTPD, AQL and AOQL – Single sampling plan OC, AOQ, ASN, ATI curves.

UNIT 5

Double sampling plan for attributes – OC, AOQ, ASN, ATI curves – Dodge and Romig tables – Sequential sampling plan for attributes.

Books for Study

1. Montgomery.D.C. (1991), Introduction to Statistical Quality Control, 2nd Edition, John Wiley and Sons.
2. S.C.Gupta and V.K.Kapoor(1999), Fundamentals of Applied Statistics, Sultan Chand and Sons.

Books for Reference

1. Grant.E.L. and Leavenworth.R.S. (1980), Statistical Quality Control, McGraw Hill.
2. Duncan A.J.(1974): Quality Control and Industrial Statistics, 4th Ed., Taraporewala& Sons.

Note to the paper setter : 60% Theory and 40% Problems

SEMESTER – VI **4 Credits (Theory) & 1Credit (Tutorial)**

DSE-2B

STAT 363: REGRESSION ANALYSIS

UNIT 1

Simple Regression model: Description of data model – Estimation and test of hypotheses – Index of fit – Predicted values and standard errors – Evaluation of fit – Analysis of residuals**.**

UNIT 2

Simple Regression model: Effect of outliers in simple linear regression – Model adequacy and residual plots – Deletion of data points – Transformation of variables – transformation to stabilize variance – Removal of hetroscedasticity – Principle of weighted least squares.

UNIT-3

Multiple regression model: Description of data model – Properties of least square estimators – Predicted values and standard errors – Multiple correlation coefficient -Selection of variables – Forward selection procedure – Backward elimination procedure – Stepwise method (algorithms only).

UNIT 4

Test of hypothesis on the linear model – Assumption about the explanatory variable – Testing a subset of regression coefficients equal to zero – Testing of equality of regression coefficients.

UNIT 5

Multicollinearity and its effects on inference and forecasting – Detection of multicollinearity – Searching of linear functions of regression coefficients – Ridge method.

Books for study

1. S.Chatterjee and B.Price(1977): Regression Analysis by Example, John Wiley & Sons, New York. Chapter 1,2,3 and relevant portions in chapters 4,5,6,7,8,9

2. N.R.Draper&H.Smith(1981), Applied Regression Analysis, Second Edition.

Books for Reference:

1. Johnston J.(1984): Econometric Methods.

Note to the paper setter: 80%Theory and 20% Problems

SEMESTER – VI **4 Credits (Theory) & 1Credit (Tutorial)**

DSC-3B

STAT 364: **DESIGN OF EXPERIMENTS**

UNIT 1

Basic principles for designing statistical experiments: Randomisation, Replication and local control techniques; determination of experimental units and notion of experimental error. Analysis of variance with one way – Two way classification; Models and estimation of parameters

UNIT 2

Completely randomized – Models and estimates of parameters and their standard error – Analysis of data arising from such design, multiple comparison tests: LSD

UNIT 3

Randomized block design - Models and estimates of parameters - Estimation of one and two missing observations – efficiency of RBD relative to CRD -

UNIT 4

Latin Square Design – Models and estimates of parameters - Estimation of one and two missing observations – Efficiency of LSD relative to CRD and RBD

UNIT 5

Factorial Experiments: 2^2, 2^3 and 3^2 designs; estimation of main effects and interactions and their standard errors.

Books for study:

1. Das.M.N and Giri.N.C(1986): Design and Analysis of Experiments, Wiley Eastern Limited.
2. S.C.Gupta and V.K.Kapoor(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.

Books for Reference:

1. W.T.Federer(1967): Experimental Design, Oxford & IBH Publishing Co.
2. Montgomery D.C.(1991): Design and Analysis of Experiments, John Wiley.

Note to the paper setter: 80%Theory and 20% Problems

SEMESTER – VI **6 Credits**

DSE-4B

STAT 365: PROJECT WORK

Guidelines for the Project work:

1. A project work shall be normally offered in the third year (sixth semester).
2. A project work shall be assessed for a maximum of 100 marks. The assessment will be based on the project report, presentation and viva-voce.
3. A project may be undertaken by a group of students and the maximum number of students in a team shall not exceed five. However, the project report shall be submitted by each member of the team separately.
4. A project work shall be supervised by a faculty member assigned by the Head of the Department.
5. There shall be an internal examiner for the evaluation of the project work.
6. A project work should encourage a student to be able to interact with the end user.
7. A project work should be chosen such that there is enough scope to apply and demonstrate the statistical techniques learnt in the course.

A project work report shall clearly state the problem addressed, the methodology adopted, the assumptions and the hypotheses formulated, any previous references to the study undertaken, statistical analyses performed and the broad conclusion drawn.

SEMESTER – VI **3 Credits**

GE-2

STAT 366: DATABASE MANAGEMENT SYSTEMS

UNIT 1

Introduction - DBMS Basic Concepts - Purpose of Database Systems Database System / File System - Overall System architecture Database Languages Classifications Data Models

UNIT 2

Entity relationship model: Mapping constraints Primary Keys Foreign Keys Structural Constraints. ER notations - ER model examples Enhanced Entity Relationship Model: EER Concepts like Generalization, Specialization, Union, Category, Disjoint, Overlapping etc. EER model examples

UNIT 3

Relational DataBase Design ER/EER to Relational Mapping algorithm – Relational Model: Structure Formal Query Languages Relational Algebra Informal Design Guidelines Functional Dependencies Normalization upto Third Normal Form

UNIT 4

SQL Basics of SQL DDL DML DCL TCL Commands in detail with examples

UNIT 5

PL/SQL: Stored Procedure Concepts Procedure Functions Cursors - Triggers.

Books for study:

1. H.F. Korth and A.Silberschatz (1988): Database System Concepts, McGraw Hill Publication.
2. Albert Lulushi (1997): Developing ORACLE FORMS Applications, Prentice Hall

Books for Reference:

1. RamezElmasri and B. Navathe, Fundamentals of Database Systems (Chapters1, 2, 3, 4.1, 7, 8, 9, 14), 3/e, Addison Wesley.