# THIRUVALLUVAR UNIVERSITY

## BACHELOR OF SCIENCE
## B.Sc. STATISTICS
## DEGREE COURSE

## (With effect from 2020 - 2021)

### The Course of Study and the Scheme of Examinations

| S. No. | Part | Study Components / Course Title | | Ins. Hrs / week | Credit | Title of the Paper | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **SEMESTER I** | | | | | **CIA** | **Uni. Exam** | **Total** |
| 1. | I | Language | Paper-1 | 6 | 4 | Tamil/Other Languages | 25 | 75 | 100 |
| 2. | II | English (CE) | Paper-1 | 6 | 4 | **Communicative English I** | 25 | 75 | 100 |
| 3. | III | Core Theory | Paper-1 | 6 | 4 | Descriptive Statistics | 25 | 75 | 100 |
| | III | Core Practical | Practical-1 | 4 | 0 | Statistical Practical-I | 0 | 0 | 0 |
| 4. | III | Allied -1 | Paper-1 | 6 | 3 | Mathematics-I | 25 | 75 | 100 |
| **5.** | **III** | **PE** | **Paper 1** | **6** | **3** | **Professional English I** | **25** | **75** | **100** |
| 6. | IV | Environmental Studies | | 2 | 2 | Environmental studies | 25 | 75 | 100 |
| | | **Sem. Total** | | **36** | **20** | | **150** | **450** | **600** |
| | | | | | | | | | |
| | | **SEMESTER II** | | | | | **CIA** | **Uni. Exam** | **Total** |
| 7. | I | Language | Paper-2 | 6 | 4 | Tamil/Other Languages | 25 | 75 | 100 |
| 8. | II | English (CE) | Paper-2 | 6 | 4 | **Communicative English II** | 25 | 75 | 100 |
| 9. | III | Core Theory | Paper-2 | 5 | 4 | Probability and Random Variables | 25 | 75 | 100 |
| 10. | III | Core Practical | Practical-1 | 3 | 2 | Statistical Practical-I | 25 | 75 | 100 |
| 11. | III | Allied-1 | Paper-2 | 6 | 5 | Mathematics-II | 25 | 75 | 100 |
| **12.** | **III** | **PE** | **Paper 1** | **6** | **3** | **Professional English II** | 25 | 75 | 100 |
| 13. | IV | Value Education | | 2 | 2 | | 25 | 75 | 100 |
| 14. | IV | Soft Skill | | 2 | 1 | | 25 | 75 | 100 |
| | | **Sem. Total** | | **36** | **25** | | **200** | **600** | **800** |
| | | | | | | | | | |
| | | **SEMESTER III** | | | | | | | |
| 15. | I | Language | Paper-3 | 6 | 4 | Tamil/Other Lang. | 25 | 75 | 100 |
| 16. | II | English | Paper-3 | 6 | 4 | English | 25 | 75 | 100 |
| 17. | III | Core Theory | Paper-3 | 4 | 4 | Distribution Theory | 25 | 75 | 100 |
| | III | Core Practical | Practical-2 | 2 | - | Statistical Practical-II | - | - | - |
| 18. | III | Allied | Paper-3 | 4 | 3 | Numerical Methods | 25 | 75 | 100 |
| | | Allied Practical | Practical-1 | 2 | - | Numerical Methods and Programming in C | - | - | - |
| 19. | IV | Skill Based Subject | Paper-1 | 3 | 2 | Elementary Mathematics | 25 | 75 | 100 |
| 20. | IV | Non-Major Elective | Paper-1 | 3 | 2 | Statistical Methods-I | 25 | 75 | 100 |
| | | **Sem. Total** | | **30** | **19** | | **150** | **450** | **600** |
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| | | **SEMESTER IV** | | | | | | | |
| 21. | I | Language | Paper-4 | 6 | 4 | Tamil/Other Lang. | 25 | 75 | 100 |
| 22. | II | English | Paper-4 | 6 | 4 | English | 25 | 75 | 100 |
| 23. | III | Core Theory | Paper-4 | 4 | 4 | Sampling Theory | 25 | 75 | 100 |
| 24. | III | Core Practical | Practical-2 | 4 | 4 | Statistical Practical-II | 25 | 75 | 100 |
| 25. | III | Allied | Paper-4 | 3 | 3 | Programming in C | 25 | 75 | 100 |
| 26. | III | Allied Practical | Practical-1 | 3 | 2 | Numerical Methods and Programming in C | 25 | 75 | 100 |
| **27.** | **IV** | **NMSDC : Digital Skills for Employability** | **Paper-2** | **2** | **2** | **Office Fundamentals** | **25** | **75** | **100** |
| 28. | IV | Non-Major Elective | Paper-2 | 2 | 2 | Statistical Methods-II | 25 | 75 | 100 |
| | | **Sem. Total** | | **30** | **25** | | **200** | **600** | **800** |
| | | | | | | | | | |
| | | **SEMESTER V** | | | | | | | |
| 29. | III | Core Theory | Paper-5 | 6 | 4 | Estimation Theory | 25 | 75 | 100 |
| 30. | III | Core Theory | Paper-6 | 5 | 4 | Statistical Quality Control | 25 | 75 | 100 |
| 31. | III | Core Theory | Paper-7 | 5 | 4 | Operations Research | 25 | 75 | 100 |
| 32. | III | Core Theory | Paper-8 | 5 | 4 | Applied Statistics | 25 | 75 | 100 |
| | III | Core Practical | Practical-3 | 3 | - | Statistical Practical-III | - | - | - |
| 33. | III | Internal Elective | Paper-1 | 4 | 3 | (Choose 1 out of 2)<br>A. Demography<br>B. Database Management System | 25 | 75 | 100 |
| 34. | IV | Skill Based Subject | Paper-2 | 2 | 2 | Indian Official Statistics | 25 | 75 | 100 |
| | | **Sem. Total** | | **30** | **21** | | **150** | **450** | **600** |
| | | | | | | | | | |
| | | **SEMESTER VI** | | | | | | | |
| 35. | III | Core Theory | Paper-9 | 6 | 4 | Testing Statistical Hypotheses | 25 | 75 | 100 |
| 36. | III | Core Theory | Paper-10 | 5 | 4 | Design of Experiments | 25 | 75 | 100 |
| 37. | III | Core Theory | Paper-11 | 5 | 4 | Stochastic Processes | 25 | 75 | 100 |
| 38. | III | Core Practical | Practical-3 | 4 | 4 | Statistical Practical-III | 25 | 75 | 100 |
| 39. | III | Compulsory Project | Paper-12 | 5 | 5 | Group / Individual Project | 25 | 75 | 100 |
| 40. | III | Internal Elective | Paper-2 | 3 | 3 | (Choose 1 out of 2)<br>A. Mathematical Economics<br>B. Real Analysis | 25 | 75 | 100 |
| 41. | III | Internal Elective | Paper-3 | 3 | 3 | (Choose 1 out of 2)<br>A. Statistical Genetics<br>B. Actuarial Statistics | 25 | 75 | 100 |
| **42.** | **III** | **Data Analytics with Advance Tools for Employability** | **Paper-4** | **2** | **2** | **Project Based Learning III** | **25** | **75** | **100** |
| 43. | V | Extension Activities | | | 1 | | 100 | 0 | 100 |
| | | **Sem. Total** | | **30** | **30** | | **300** | **600** | **900** |
| | | **Grand Total** | | | **140** | | | | **4300** |
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| | | | | | | | | | |

| Part | Subject | Papers | Credit | Total Credits | Marks | Total Marks |
|---|---|---|---|---|---|---|
| Part I | Languages | 4 | 4 | 16 | 100 | 400 |
| Part II | Communicative English & English | 4 | 4 | 16 | 100 | 400 |
| Part III | Allied (Odd Semester) | 2 | 3 | 6 | 100 | 200 |
| | Allied (Even Semester) | 2 | 5 | 10 | 100 | 200 |
| | Allied Practical | 1 | 2 | | 100 | 100 |
| | Electives | 3 | 3 | 9 | 100 | 300 |
| | Core | 11 | (3-5) | 44 | 100 | 1100 |
| | Core practical | 3 | (2-3) | 10 | 100 | 300 |
| | Professional English | 2 | 3 | 6 | 100 | 200 |
| | Compulsory Project (Group/Individual Project) | 1 | 5 | 5 | 100 | 100 |
| Part IV | Environmental Science | 1 | 2 | 2 | 100 | 100 |
| | Soft skill | 1 | 1 | 1 | 100 | 100 |
| | Value Education | 1 | 2 | 2 | 100 | 100 |
| | Lang. & Others /NME | 2 | 2 | 4 | 100 | 200 |
| | Skill Based | 4 | 2 | 8 | 100 | 400 |
| Part V | Extension Activities | 1 | 1 | 1 | 100 | 100 |
| | **Total** | **43** | | **140** | | **4300** |

THIRUVALLUVAR UNIVERSITY
VELLORE - 632 115

# B.Sc. STATISTICS

CBCS Pattern
(With effect from 2020-2021)

## List of Core / Allied / Elective / Skill based / Non-Major Elective Subjects

### Core Subjects

1. Descriptive Statistics
2. Probability and Random Variables
3. Statistical Practical - I
4. Distribution Theory
5. Sampling Theory
6. Statistical Practical - II
7. Estimation Theory
8. Statistical Quality Control
9. Operations Research
10. Applied Statistics
11. Testing Statistical Hypotheses
12. Design of Experiments
13. Stochastic Processes
14. Statistical Practical – III
15. Project with Viva-voce

### Allied Subjects (for students of Statistics)

1. Mathematics - I
2. Mathematics – II
3. Numerical Methods
4. Programming in C
5. Allied Practical – I (Numerical Methods and Programming in C )

## Core Elective Subjects (for students of Statistics)

1. Demography
2. Database Management System
3. Statistical Genetics
4. Mathematical Economics
5. Real Analysis
6. Actuarial Statistics

## Skill based Subjects (for students of Statistics)

1. Elementary Mathematics
2. Statistical Data Analysis – I (Using R Programming)
3. Indian Official Statistics
4. Statistical Data Analysis – II (Software based)

## Non-Major Elective Subjects (for students of other departments)

1. Statistical Methods – I
2. Statistical Methods - II

# SEMESTER III
## PAPER - 3
### DISTRIBUTION THEORY

## Course Objective(s)

To enable the students to understand the properties and applications of various probability functions.

**UNIT - I**

Discrete distributions: Binomial, Trinomial and Multinomial distributions and their properties - Poisson, Negative Binomial and Geometric distributions and their properties.

**UNIT - II**

Continuous distributions: Normal, Uniform, Exponential, Gamma and Beta distributions and their properties.

**UNIT - III**

Bivariate Normal Distribution and its properties. Partial and multiple correlation and regression - Concepts and simple problems.

**UNIT - IV**

Basic Central Limit Theorem (statement only) - Limiting distributions : Poisson distribution as a limiting case of Binomial - Poisson distribution as a limiting case of Negative Binomial distribution - Convergence of Binomial, Poisson, Gamma and Chi-square distribution to Normal distribution using Moment generating function.

**UNIT - V**

Order statistics - distribution of first, $n^{th}$ and $i^{th}$ order statistics, joint distribution of $r^{th}$ and $s^{th}$ order statistics - distribution of median and range. Simple problems.

**Text Books:**

1. Gupta, S. C and Kapoor, V. K (2002), Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.

**Reference Books:**

1. Hogg, R. V and Craig, A. T (2002), Introduction to Mathematical Statistics, Pearson Education Asia, India.

**Course Outcomes**

1. After studied unit-1, the student will be able to know various discrete distributions
2. After studied unit-2, the student will be able to know various continuous distributions
3. After studied unit-3, the student will be able to know random variables and its properties
4. After studied unit-4, the student will be able to know Limiting distribution and convergence concepts
5. After studied unit-5, the student will be able to know the concept of order statistics

**ALLIED - 2**

**PAPER - 3**

**NUMERICAL METHODS**

## Course Objective(s)

To enable the students to establish mathematical functions using numerical data and to estimate functional relationship, interpolate and extrapolate the value of dependent variable, find maxima and minima using differentiation

## UNIT - I

Finite differences - forward and backward differences, operators E and $\Delta$, and their basic properties, Interpolation with equal intervals: Newton's forward and backward differences - simple problems.

## UNIT - II

Interpolation with unequal intervals: Divided differences and their properties, Newton's divided differences formula and Lagrange's formula for interpolation-simple problems.

## UNIT - III

Central difference interpolation formula - gauss forward and backward differences formulae - Stirling, Bessel's Everett's central difference formula.

## UNIT - IV

Inverse interpolation - Lagrange's method - iteration of successive approximation method-simple problems. Numerical differentiation - Numerical differentiation upto $2^{nd}$ order only - simple problems.

## UNIT - V

Numerical intergration - Trapezoidal rule - simpson's $1/3^{rd}$ and $3/8^{th}$ rules - Weddle's rule - Euler's summation formula. Numerical method of solution of ordinary differential equations - Taylor's series method - Euler method and Runga Kutta upto second order - simple problems.

**Text Books:**

1. Numerical Methods by P.Kandasamy,K.Thilagavathy and K.Gunavathi,S.Chand, New Delhi.
2. Numerical methods in Science and Engineering by M.K. Venkataraman, National publishing house, Chennai.

**Reference Books:**


1. Calculus of finite differences and Numerical analysis by Gupta-Malik, Krishna Prakastan Mandir, Meerut.
2. Numerical methods in Science and Engineering by M.K. Venkataraman, National publishing house, Chennai.
3. Numerical Analysis by B.D. Gupta, Konark publishing.
4. Calculus of finite differences and Numerical Analysis by Saxena, S. Chand & Co.
5. Numerical mathematics by M.M.Ramasamy and Palaniappan.
6. Introductory Methods of Numerical Analysis by S.S.Sastry,Printice Hall of India,New Delhi.


**Course Outcomes**

1. After studied unit - 1, the student will be able to know how to solve problem of interpolation with equal intervals
2. After studied unit - 2, the student will be able to know how to solve problem of interpolation with unequal intervals
3. After studied unit - 3, the student will be able to know the concept of central differences formula and its usage of solving problem
4. After studied unit - 4, the student will be able to know how to solve problem with inverse interpolation
5. After studied unit - 5, the student will be able to know the concept of numerical differentiation and integration and its usage of real time applications

**SKILL BASED SUBJECT**

**PAPER - 1**

**ELEMENTARY MATHEMATICS**

## Course Objective(s)

The course introduces students to the fundamental principles, concepts and knowledge in the areas of Differential and Integral Calculus.

### UNIT - I

Jacobians - Total differential - maxima and minima functions of 2 and 3 independent variable, Lagrange's method (without proof), problems on these concepts.

### UNIT - II

Polar coordinates - Angle between radius vector and tangent - Angle between two curves, Curvature, Radius of Curvature in Cartesian and Polar coordinates, p-r equation, Evolutes.

### UNIT - III

Asymptotes: Methods (without proof) of finding asymptotes of rational algebraic curves with special cases.

### UNIT - IV

Reduction formulae, Beta and Gamma Functions - Properties and Problems.

### UNIT - V

Double Integrals - Change of order of Integration - Triple Integrals - Applications to Area, Surface Area and Volume.

**Text Books:**

1. S.Narayanan and T.K.Manicavachagom Pillay (2004) *Calculus.* S.Viswanathan Printers & Publishers Pvt. Ltd. Chennai.

**Reference Books:**

1. P.Kandasamy, K.Thilagavathy (2004), Mathematic for B.Sc. Vol.-I, II, III & IV, S.Chand & Company Ltd., New Delhi-55.

2. Shanti Narayan (2001) *Differential Calculus*. Shyamlal Charitable Trust, New Delhi.
3. Shanti Narayan (2001) *Integral Calculus.* S.Chand & Co. New Delhi.
4. S.Sudha (1998) *Calculus.* Emerald Publishers, Chennai.
5. G.B.Thomas and R.L.Finney. (1998) *Calculus and Analytic Geometry*, Addison Wesley (9th Edn.), Mass. (Indian Print)
6. P.R.Vittal. (2004) *Calculus*, Margham Publication, Chennai

**Course Outcomes**

1. After studied unit - 1, the student will be able to know basics of differential calculus
2. After studied unit - 2, the student will be able to know the various methods solving differential calculus
3. After studied unit - 3, the student will be able to know solving asymptote problems
4. After studied unit - 4, the student will be able to know solving problems using reduction formula
5. After studied unit - 5, the student will be able to know solving double integral problems

## NON-MAJOR ELECTIVE

## PAPER -1

### STATISTICAL METHODS - I

**Course Objective(s)**

To enable students to learn basics of statistics and its applications

**UNIT - I**

Statistics - Definitions - limitation of statistics - collection of data - primary data - secondary data - Diagrammatic and Graphical representation of data.

**UNIT - II**

Descriptive Measures - Mean, Median, mode, standard deviation, skewness and kurtosis (ungrouped data only).

**UNIT - III**

Concept of sample and Population - Preparation of questionnaire and Pre-testing - Simple random, Stratified random and Systematic sampling techniques.

**UNIT - IV**

Study of relationship between variables: Concept of correlation - Karl Pearson and Spearman rank correlation - simple problems. Qualitative: Contingency tables - Measures of Association. Concept of simple regression - simple problems.

**UNIT - V**

Elements of Compound interest (nominal and effective rates of interest, annuities certain, present values, accumulated amounts, deferred annuities) - the functions included in compound interest - tables and their uses.

**Text Books:**

1. Gupta,S.P. (2014): Statistical Methods, Sultan Chand& Sons Pvt Ltd. New Delhi.
2. Federation of Insurance Institutes Study Courses - Mathematical Basis of Life Assurances F1,2.

**Reference Books:**

1. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of Applied Statistics, Sultan Chand & Sons.

**Course Outcomes**

1. After studied unit - 1, the student will be able to know visualization of data
2. After studied unit - 2, the student will be able to know computations of various statistical measures of data

3. After studied unit - 3, the student will be able to know sample selection and various sampling procedures
4. After studied unit - 4, the student will be able to know relationship among variables and fitting of simple regression model
5. After studied unit - 5, the student will be able to know computation of interest calculations

# SEMESTER IV

## PAPER - 4

## SAMPLING THEORY

### Course Objective(s)

To enable the students to understand and apply the sampling procedures to different situations.

**UNIT - I**

Design - Organization and execution of sample surveys - principle steps in sample survey - Pilot survey - principles of sample survey - sampling and non-sampling errors - advantages of sampling over complete census - limitations of sampling.

**UNIT - II**

Sampling from finite population - simple random sampling with and without replacement - unbiased estimate of the mean, variance of the estimate of the mean finite population correction estimation of standard error from a sample - determination of sample size.

**UNIT - III**

Stratified random sampling - properties of the estimates - unbiased estimates of the mean and variance of the estimates of the mean - optimum and proportional allocations - relative precision of a stratified sampling and simple random sampling - estimation of gain in precision in stratified sampling.

**UNIT - IV**

Systematic sampling - estimate of mean and variance of the estimated mean - comparison of simple and stratified with systematic random sampling.

**UNIT - V**

Ratio estimators: Ratio estimates, variance of the ratio estimates - Bias of the ratio estimates. Regression estimators: Linear regression estimate regression estimates with pre-assigned b-regression estimates when b is computed from the sample.

**Text Books:**

1. William, G. Cochran (1984): Sampling techniques, Wiley Eastern.

**Reference Books:**

1. Des Raj (1976): Sampling theory, Tata McGraw Hill.
2. Daroga Singh & Chaudhary, F.S. (1986): Theory and Analysis of Sample Survey

Designs. Wiley Eastern.

3. Sukhatme P.V. et al (1984): Sample survey methods and its applications, Indian Society of Agricultural Statistics, New Delhi.

4. Murthy, M.N. (1967): Sampling theory and methods, Statistical Publishing Society, Calcutta.

5. Sampath S. (1999): Sampling theory and methods. New Age International Ltd.

6. Engineering Updates.

7. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of applied statistics, Sultan Chand & Sons.

**Course Outcomes**

1. After studied unit-1, the student will be able to know the concept of sample survey and its features
2. After studied unit-2, the student will be able to know simple random sampling procedure
3. After studied unit-3, the student will be able to know stratified random sampling procedures
4. After studied unit-4, the student will be able to know systematic sampling procedure
5. After studied unit-5, the student will be able to know ratio and regression estimators

CORE **PRACTICAL II**

**STATISTICAL PRACTICAL-II**

## Course Objective(s)

To enable students to solve problems related to estimation and hypothesis testing, statistical quality control techniques and design and analysis of experiments

Problems relating to the following topics which are covered in Semester III and Semester IV shall form the basis for practical:

1. Distribution Theory (problems related to fitting of various distributions such as binomial, poison, normal, computation of correlation, partial and multiple correlation coefficients)
2. Sampling Theory (problems related to estimates of population mean and variances, under simple random sampling, stratified random sampling, systematic random sampling, ration and regression estimators)

## Text Books

Books prescribed in the respective core papers shall be used.

**Note**

The maximum marks for continuous internal assessment and end semester University examination for Statistical Practical-II shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test (25 marks) and record work (15 marks). The question paper at the end semester examination shall consist of **four questions with internal choice**. A candidate shall attend all the four questions, each of which shall carry 15 marks.

## ALLIED -2

## PAPER - 4

# PROGRAMMING IN 'C'

**Course Objective(s)**

**To enable the students to understand and develop programs in C.**

**UNIT - I**

Introduction to "C", variables, data types-declarations, type conversions, increment and decrement, Bitwise, Logical and Assignment operators.

**UNIT - II**

Expression and conditional expressions, control structures, If-Else, SWITCH, WHILE, FOR and DO WHILE loop structures. Break continue, GO and Label statements. Function, function returning, Non-integers, Function arguments -Static and register variables.

**UNIT - III**

Arrays and Strings - Array Declaration, Multi dimensional Arrays Strings/Character Arrays, Array initialization-Pointers and addresses. Pointers and Arrays-Pointer to function.

**UNIT - IV**

Structures and functions, Array of structures Fields, Unions-type definition standard input and output - formatted output - output - Access to the standard library.

**UNIT - V**

File Access, File handling in C - File descriptions - Error handling - 'Low level i/o-Read and Write'. Open, Create, Close, Unlike-Random Access - seek and I seek.

**Text Books:**

1. Balagurusamy, E. (1997): ANSI 'C' Programming, Tata-McGraw Hill Publishers Ltd.

**Reference Books:**

1. Yaswant Kanetkar (1997): Let Us 'C',BPB Publications, New Delhi.
2. Bruce,H.Hunter: Introduction to 'C'

**Course Outcomes**

1. After studied unit - 1, the student will be able to know the basic data types of programming in c
2. After studied unit - 2, the student will be able to know the various control structures and its usage
3. After studied unit - 3, the student will be able to know the concept of arrays and pointers
4. After studied unit - 4, the student will be able to know the concept of structures and unions.
5. After studied unit - 5, the student will be able to know to file structures and its manipulations

## ALLIED PRACTICAL
## NUMERICAL METHODS AND PROGRAMMING IN C

**Course Objective(s)**

To enable students to solve problems related to numerical methods using programming in C

Problems relating to the following topics which are covered in Semester III and Semester IV shall form the basis for practical:

Problems relating to the following topics shall form the basis for the practical.

1. Summation of Series: Sin(x), Cos(x), Exp(x), (Comparison with built in functions)
2. String Manipulation: Counting the no. of vowels, consonants, words, white spaces in a line of text and array of lines. Reverse a string & check for palindrome. Substring detection, count and removal - Finding and replacing substrings
3. Solution of polynomial equation - Newton Raphson method
4. Solution of system of simultaneous equation - Gauss elimination method.
5. Interpolation - Lagrange interpolation.
6. Numerical integration by Trapezoidal, Simpson's and Weddle's rules - Calculate the value of $\pi$ (up to five decimal places).
7. Check the accuracy of the built in functions Sin(x), Cos(x),(x in radians) $e^x$, $e^{-x}$ Generation of Fibonacci Sequence.
8. Matrix addition, multiplication, inverse, transpose, determinant of square matrix. Solution of simultaneous equations by Iterative methods and by using inverse.

**Text Books**

Books as prescribed in Allied papers in the semester III and IV.

**Note**

The maximum marks for continuous internal assessment and end semester University examination for Allied Practical-I shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test and record work. The question paper at the end semester examination shall consist of **four questions with internal choice**. A candidate shall attend all the four questions, each of which shall carry 15 marks.

## SKILL BASED SUBJECT
## PAPER - 2 (PRACTICAL-I)

### STATISTICAL DATA ANALYSIS-I (USING R PROGRAMMING)

**Course Objective(s)**

To enable students to utilize the theoretical knowledge gained in the core papers and to develop computational and technical skills for real life applications emphasizing the importance of R programming.

Problems relating to the following topics shall form the basis for the practical.

1. Using R command-Operations on vectors and matrices. Creating and Manipulation of data frames - user-defined functions.
2. Matrix addition, multiplication, inverse, transpose, determinant and trace of matrix.
3. Construction of table with one or more variables. Graphical procedures– Pie chart, Bar chart, Histograms and Boxplots.
4. Computation of various descriptive measures such as Measures of central tendency, measures of dispersion, skewness and kurtosis. Computation of correlations and regression co-efficient.

## Text Books

Purohit, S. G., Gore, S. D., and Deshmukh, S. R. (2009). Statistics Using R, Narosa Publishing House, NewDelhi.

## E-Resources

www.r-project.org

**Note**

The maximum marks for continuous internal assessment and end semester University examination for Statistical Data Analysis-I(Using R) shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test and record work. The question paper at the end semester examination shall consist of **four questions with internal choice**. A candidate shall attend all the four questions, each of which shall carry 15 marks.

# NON-MAJOR ELECTIVE
# PAPER 2
# STATISTICAL METHODS - II

**Course Objective(s)**

To enable students to learn the concept of estimation of unknown parameters of the population and hypothesis testing problem.

**UNIT - I**

Population growth and change - arithmetic, geometric and exponential growth rates - Population estimation and projection.

**UNIT - II**

Measures of mortality - Crude and Specific rates- Infant mortality rate - direct and indirect standardization of death rates - Complete life table.

**UNIT - III**

Estimation - Point estimation - interval estimation - mean - variance - proportions - simple problems.

**UNIT - IV**

Parametric Tests - Testing of significance of small and large sample tests - t-test, chi-square test - F test - z-test.

**UNIT - V**

Non- Parametric tests - Sign test, Wilcoxon test, Mann-Whitney U Test. Median test, Run test, Kolmogorov - Smirnov One Sample test. Chi- Square Tests - Goodness of fit - Test of independence of attributes.

**Text Books:**

1. Gupta,S.P (2014): Statistical Methods, Sultan Chand & Sons .
2. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of Applied Statistics, Sultan Chand & Sons.

**Reference Books:**

1. Rohatgi, V.K. (1984) An introduction to probability theory and Mathematical Statistics, Wiley Eastern.

**Course Outcomes**

1. After studied unit - 1, the student will be able to know computation of population growth rate
2. After studied unit - 2, the student will be able to know the concept of mortality and its calculations
3. After studied unit - 3, the student will be able to know the concept of estimation of parameter
4. After studied unit - 4, the student will be able to know various parametric testing procedures
5. After studied unit - 5, the student will be able to know various non-parametric testing procedures

## SEMESTER V
## PAPER - 5
## ESTIMATION THEORY

**Course Objective(s)**

To enable the students to understand and apply various estimation procedures

**UNIT - I**

Sampling distributions - concept - distributions of mean and variance from Normal population. Sampling distributions: Chi-square, Student's t and F distributions - Derivation of their density functions and their properties

**UNIT - II**

Point Estimation - Problem of Point estimation - Properties of estimators - Consistency and Efficiency of an estimator. Sufficiency of a statistic - Neyman - Fisher factorization theorem (discrete case) - Simple problems.

**UNIT - III**

Unbiasedness - Properties, MVUE, BLUE, Rao - Blackwell theorem-Sufficiency and completeness, Lehman - Scheffe theorem, Cramer - Rao inequality - simple problems.

**UNIT - IV**

Methods of estimation: Method of Moments, Method of Maximum Likelihood, Method of minimum chi-square, Method of modified minimum chi-square, method of least squares - properties of estimators obtained by these methods - simple problems.

**UNIT - V**

Interval Estimation - Confidence Interval for proportions, mean(s), variance, and variance ratio based on chi square, student's t, F and Normal distributions. Tests of significance: concepts - tests based on normal, t, F, and Chi Square.

**Text Books:**


1. Mood, AM. Graybill , F.A. and Boes, D.C. (1974) : Introduction to the theory of Statistics, McGraw Hill.
2. Hogg R.V. and Craig, A.T. (1972): Introduction to mathematical statistics, 3rd edition, Academic Press, USA.
3. Goon, A.M. Gupta, M.K., and Das Gupta, B. (1980): An outline of statistical theory, Vol.I, 6th revised ed. World Press limited, Calcutta.
4. Gupta, S.C. and Kapoor, V.K. (2014): Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

**Reference Books:**


1. Hoel, P.G. (1971) : Introduction to mathematical Statistics, Asia publishing house.
2. Rohatgi, V.K. (1984) An introduction to probability theory and mathematical statistics, Wiley Eastern.
3. Degroot, M.H. (1975): Probability and Statistics, Addison – Wesley
4. Marek Fisz (1961): Probability theory and Mathematical statistics, John Wiley.
5. Spiegal, M.R. (1982): Theory and problems of probability and statistics, Schaum's outline series, McGraw Hill
6. Snedecor, G.W. and Cochran, W.G. (1967): Statistical methods 6th edition, Oxford IBH Publishing Co.
7. Wilks, S.S. (1962): Mathematical statistics - John Wiley & Sons.


**Course Outcomes**

1. After studied unit-1, the student will be able to know sampling distributions and its applications
2. After studied unit-2, the student will be able to know point estimation
3. After studied unit-3, the student will be able to know properties of estimators and related results
4. After studied unit-4, the student will be able to know various methods of estimation
5. After studied unit-5, the student will be able to know interval estimation and test of significance

## PAPER - 6

### STATISTICAL QUALITY CONTROL

**Course Objective(s)**

To enable the students to know the concepts of process control and product control

**UNIT - I**

Need for Statistical Quality Control techniques in Industry - Causes of Quality variation control charts - Use of the Shewhart - control chart - Specification and tolerance limits - 3 sigma limits - warning limits - application of theory of runs in quality control.

**UNIT - II**

Control chart for variables - X-bar chart, R chart, σ chart - purpose of the charts - Basis of sub grouping - plotting X-bar and R results - determining the trial control limits - Interpretation of control charts X-bar and R.

**UNIT - III**

Control chart for attributes - purpose of the chart - p chart - np chart - construction of p and np chart - choice between chart for P and chart for np - construction of c-chart.

**UNIT - IV**

Acceptance of sampling plans for attributes - Producer's risk and consumer's risk - concepts of AQL, LTPD, AOQ, AOQL, ATI and ASN - single, double and Multiples sampling plans - OC, AOQ, ATI curves for single and double sampling plans.

**UNIT - V**

Variable sampling plans - Sigma known and sigma unknown determination of n and k for one sided specification - OC curve.

**Text Books:**


1. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of applied statistics, Sultan Chand & Sons.
2. Montgomery, D.C. (1983): Introduction to Statistical Quality Control, John Wiley & Sons.


**Reference Books:**


1. Grant, E,L. and Laven Worth, R.S.: Statistical Quality Control, McGraw Hill.
2. Ekambaram, S K. (1963): Statistical basis of Acceptance sampling, Asia Publishing House.

**Course Outcomes**

1. After studied unit-1, the student will be able to know the need of statistical quality control techniques
2. After studied unit-2, the student will be able to know control charts for variables and its applications in industries
3. After studied unit-3, the student will be able to know control charts for attributes and its applications in industries
4. After studied unit-4, the student will be able to know acceptance sampling plans for attributes
5. After studied unit-5, the student will be able to know the concept of variable sampling plans and it features.

# PAPER - 7

## OPERATIONS RESEARCH

**Course Objective(s)**

To enable the students gain knowledge about various optimization techniques

**UNIT - I**

Introduction to OR, Nature, Scope, Functions, Linear programming problem - Formulation of LPP - Solving the LPP by graphical method.

**UNIT - II**

Slack variable - surplus variable - Solving the LPP by simplex method - artificial variable - Big-M method, Duality in LPP, Dual simplex method.

**UNIT - III**

Transportation problem - obtaining initial, feasible and optimal solutions. Optimality test degeneracy, Unbalanced transportation problem, Assignment problem, and unbalanced assignment problem - Traveling salesman problem.

**UNIT - IV**

Game Theory - Two person zero sum games, The maximin - minimax principle - Games without saddle points - Mixed strategies - Graphical solution of 2xn and mx2 games Dominance property. Sequencing - 'n' jobs through 2 machines - 'n' jobs through 3 machines - 'n' jobs through 'm' machines, Two jobs and 'm' machines.

**UNIT - V**

Network analysis by CPM / PERT basic concepts - constraints in Network - construction of the network - Time calculations - Concepts of three floats in Network Analysis - finding optimum project duration and minimum project cost, finding expected project time and variance.

**Text Books:**

1. Kanti Swamp et al: Operations Research, sutan chand and Sons, New Delhi.

2. Sharma J.K. (2001): Operations Research. Theory and applications, Macmillan India Ltd.

**Reference Books:**

1. Handy A. Taha (1996): Operations Research, 6 ed. Prentice Hall of India
2. Goel & Mittal (1982): Operations Research, Pragati Prakashan, Meerut.

3. Gupta R.K.(1985): Operations Research, Krishna Prakashan, Mandir, Meerut.
4. Schaum's outline series: Operations Research.
5. Frederick S.Hillier & Gerald J.Lieberman: (1987) Operations Research, CBS publishers & Distributors, Delhi.
6. Sharma J.K. (2002): Operations Research. Problems and solutions, Macmillan India Ltd.

**Course Outcomes**

1. After studied unit - 1, the student will be able to know the basics of optimization techniques
2. After studied unit - 2, the student will be able to know procedures of solving linear programming problems.
3. After studied unit - 3, the student will be able to know solving transportation and assignment problems.
4. After studied unit - 4, the student will be able to know game theory and solving sequencing problems
5. After studied unit - 5, the student will be able to know critical path method of solving network problems.

## PAPER - 8

## APPLIED STATISTICS

**Course Objective(s)**

This course introduces the basic Statistical tools in time related Variables, economic variables. To enable the students understand index numbers and other Statistical tools applied to demographic and chorological data

**UNIT - I**

Time series - Concept - Components of time Series - Additive and multiplicative models - Measurement of trend - free hand method - semi average method - Moving average method - Least square method.

**UNIT - II**

Measurement of seasonal variations - Simple average method - Ratio to trend method - Ratio to moving average method - Link relative method - Variate Difference method.

**UNIT - III**

Index Numbers - uses - classification of index numbers - Problems in the construction of index numbers - Methods of constructing index numbers - Unweighted index numbers - weighted index numbers.

**UNIT - IV**

Quantity index numbers - Fixed and chain base index numbers - Optimum test for index numbers - Time reversal test - factor reversal test - cost of living index numbers.

**UNIT - V**

Demand Analysis Theory and analysis of consumer's demand Law of demand, Price elasticity of demand estimation of demand curves forms of demand functions - Demand and Supply utility and indifference maps determination of price and supply and demand

**Text Books:**

1. Kapoor,V.K and Gupta,S.C (1978); Fundamentals of Applied Statistics, Sultan chand & Sons.

**Reference Books:**

1. Gupta, S.P (1999): Statistical Methods, Sultan & Sons, New Delhi.
2. Croxton, F.E & Cowdon, D.J. (1973): Applied general statistics, Prentice Hall
3. Mukhopadhyay P.(1999): Applied Statistics, New Central Book Agency Pvt. Ltd., Calcutta.

**Course Outcomes**

1. After studied unit - 1, the student will be able to know time series and its components
2. After studied unit - 2, the student will be able to know measuring seasonal variations in the data
3. After studied unit - 3, the student will be able to know index numbers and its usage
4. After studied unit - 4, the student will be able to know cost of living index and its applications
5. After studied unit - 5, the student will be able to know theory and applications of demand analysis

**INTERNAL ELECTIVE**
**PAPER - 1**

**(to choose one out of 2)**

## A. DEMOGRAPHY

### Course Objective(s)

To make the students to understand the application of statistical methods in population related problems

### UNIT - I

Sources of Demographic data - Civil Registration - Population Census - Population Registers - Errors in Demographic data - Methods of Improvement.

### UNIT - II

Mortality measurements - Merits and Demerits - general and specific rates - standardized rates - age pyramid of sex composition - Ratios, propositions and percentage rates - Population pyramids, sex ratio, crude rate, specific rates, standard rates - direct and indirect.

### UNIT - III

Fertility, Measures of fertility, General fertility rate, Specific fertility rate, Net reproduction rate, Gross reproduction rate, Crude Rate of natural increase. Definition - stable population and stationery population.

### UNIT - IV

Life table - Structure - Construction and uses - Relationship between functions of the life table - abridged life table (Concept only)

### UNIT - V

Population estimation and projection, component method of population projection Forces of mortality - Gompertz and Makcham law logistic curve fitting and its use.

### Text Books:

1. Srivastava, O.S (1983): A text book Demography, Vikas Publishing
2. Bogue, Donald, J (1976): Principles of Demography, John Wiley, New York.
2. Gupta, S.C. and V.K. Kapoor (1978): Fundamentals of Applied Statistics, Sultan Chand & Sons.

### Reference Books:

1. Spieglemen, M.(1968): Introduction to Demography, Harvard University Press.

**Course Outcomes**

1. After studied unit-1, the student will be able to know the concept of demography and its sources
2. After studied unit-2, the student will be able to know computation of mortality rates and its variants
3. After studied unit-3, the student will be able to know computation of fertility rates and its variants
4. After studied unit-4, the student will be able to know construction of life tables
5. After studied unit-5, the student will be able to know statistical tools for projection of populations

**INTERNAL ELECTIVE**
**PAPER - 1**

## B. DATABASE MANAGEMENT SYSTEM

### Course Objective(s)

To enable the students to understand classifying and grouping and retrieve the mass data.

### UNIT - I

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

### UNIT - II

Entity relationship model: Mapping constraints - Primary Keys - Foreign Key - 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 - III

Relational Data Base 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 - IV

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

### UNIT - V

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

### Text Books:

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

### Reference Books:

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

**Course Outcomes**

1. After studied unit - 1, the student will be able to know structure of DBMS.
2. After studied unit - 2, the student will be able to know the concept of entity relationship models
3. After studied unit - 3, the student will be able to know relational data based designs
4. After studied unit - 4, the student will be able to know standard query language
5. After studied unit - 5, the student will be able to know the concept of PL/SQL

**SKILL BASED SUBJECT**
**PAPER - 3**
**INDIAN OFFICIAL STATISTICS**

## Course Objectives

To enable students to learn about functions of Indian Official statistical system, functioning of various statistical organizations and applications of statistics.

### UNIT - I

Statistical System in India: Central and State Government Organizations, Functions of Central Statistical Organization (CSO), National Sample Survey Organization (NSSO) - Sampling fundamentals - sampling and non-sampling errors - large scale sample surveys.

### UNIT - II

Official statistics: Meaning, methods of collection, limitations and reliability. Principal publications containing data on the topics such as population, agriculture, industry, trade, prices, labour and employment, transport and communications - Banking and finance.

### UNIT - III

System of Collection of Agricultural Statistics - Crop forecasting and estimation - Productivity, fragmentation of holdings - Support prices - Buffer stocks - Impact of irrigation projects - Industrial statistics.

### UNIT - IV

Index Numbers - Price, Quantity and Value indices. Price Index Numbers: Construction, Uses, Limitations, Tests for index numbers - Consumer Price Index, Wholesale Price Index and Index of Industrial Production - Construction of index numbers and uses.

### UNIT - V

National Income - Measures of national income - Income, expenditure and production approaches - Applications in various sectors in India - Wage Statistics - Trade Statistics - Financial Statistics

**Text Books:**


1. Saluja, M.R (1972): Indian official statistical systems: Statistical publishing society, Calcutta and The Indian Econometric Society, Hyderabad.
2. Central Statistical Organisation (1995), Statistical System in India, Ministry of Statistics and Programme Implementation, India
3. Central Statistical Organisation (1999), Guide to Official Statistics, Ministry of Statistics and Programme Implementation, India.

**Reference Books:**

1. Goon A. M., Gupta M. K., and Dasgupta. B. (2001), Fundamentals of Statistics, Vol. 2, World Press, India.
2. Allen R. G. D. (1975). Index Numbers in Theory and Practice, Macmillan.
3. Bhaduri, A. (1990). Macroeconomics: The Dynamics of Commodity Production, Macmillan India Limited, New Delhi.
4. Branson, W. H. (1992). Macroeconomic Theory and Policy, Third Edition, HarperCollins Publishers India (P) Ltd., New Delhi.

**Course Outcomes**

1. After studied unit - 1, the student will be able to know functioning of statistical organization in India.
2. After studied unit - 2, the student will be able to know concept of official statistics
3. After studied unit - 3, the student will be able to know agricultural and industrial statistics
4. After studied unit - 4, the student will be able to know index numbers and its usages.
5. After studied unit - 5, the student will be able to know national income and its measures

**SEMESTER VI**
**PAPER - 9**
**TESTING STATISTICAL HYPOTHESES**

**Course Objective(s)**
To enable the students to get detailed idea of testing of hypotheses and Non-Parametric Tests.

**UNIT - I**

Testing of Hypothesis - Statistical Hypothesis - Simple and composite hypothesis, Null and Alternative Hypothesis - Two types of errors - critical region- powers of a test - Most powerful test - Neyman-Pearson lemma.

**UNIT - II**

Uniformly most powerful tests, Likelihood ratio criterion - Definition and test for means and variance (one sample only).

**UNIT - III**

Sequential Probability Ratio Test - Definition - properties - Wald's equation - construction of SPRT - binomial - poisson - normal distributions - OC and ASN computations.

**UNIT - IV**

Non-parametric tests - Run, Median, sign and Mann Whitney tests (one sample and two sample) problems. Wilcoxon Signed rank test, test sum test, Kolmogorov's Smirnov one sample test and Kruskal Wallis test.

**UNIT - V**

Basic ideas on decision theory - Loss functions - Risk functions - Prior distributions - Bayes Risk - Simple problems based on Bayes estimation and testing.

**Text Books:**

1. Mood, A.M. Graybill, F.A. and Boes, D.C. (1974): Introduction to the theory of Statistics, McGraw Hill.
2. Rohatgi, V.K. (1984) An introduction to probability theory and mathematical statistics, Wiley Eastern.
3. Gupta, S.C. and Kapoor, V.K.(2004): Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
4. Hogg R.V.and Craig, A.T. (1972): Introduction to mathematical statistics, 3rd edition, Academic Press, USA.
5. Goon, A.M. Gupta, M.K., and Das Gupta, B. (1980): An outline of statistical theory, Vol.I, 6th revised ed. World Press limited, Calcutta.

**Reference Books:**

1. Hod, P.G. (1971): Introduction to mathematical statistics, Asia publishing house.
2. Marek Fisz (1961): Probability theory and Mathematical statistics, John Wiley.
3. Spiegal,M.R. (1982): Theory and problems of probability and statistics, Schaum's outline series, McGraw Hill
4. Snedecor, G.W. and Cochran, W.G. (1967): Statistical methods $6^{th}$ edition

**Course Outcomes**

1. After studied unit - 1, the student will be able to know Neyman-Pearson Lemma and its applications in hypothesis testing
2. After studied unit - 2, the student will be able to know uniformly most powerful tests
3. After studied unit - 3, the student will be able to know sequential probability ratio test and its applications.
4. After studied unit - 4, the student will be able to know various nonparametric tests
5. After studied unit - 5, the student will be able to know the concept of decision theory.

## PAPER - 10
## DESIGN OF EXPERIMENTS

**Course Objective(s)**

To focus on the design and analysis of variance techniques in the statistical field experiments.

**UNIT - I**

Fundamental Principles of Experiments - Replication, Randomization and Local Control Techniques - Experimental errors - Uniformity trails - Size of experimental unit - Methods of determination of experimental units - (Maximum curvature method-Fairfield Smith's variance law).

**UNIT - II**

Analysis of Variance - one-way, two-way classification (without interaction) Multiple range tests: Newman Keul's test- Duncan's multiple range test. Tukey's test-Need for transformations Square root, angular and log transformations.

**UNIT - III**

Completely Randomized Design (CRD) and its analysis - Randomized Block Design (RBD) and its analysis - Latin Square Design(LSD) and its analysis - Merits and demerits of CRD, RBD and LSD.

**UNIT - IV**

Missing plot technique - Meaning - Least square method of estimating missing Observations - one and two observations missing in RBD and LSD - Analysis of covariance technique in CRD and RBD(without derivation) - concept of Split-plot design

**UNIT - V**

Factorial experiments - Definition $2^2$, $2^3$ and $3^2$ factorial experiments and their analysis - Analysis of BIBD and parametric Relations - concept of confounding and its merits.

**Text Books:**


1. Das M.N and Giri N.C (1986) Design and Analysis of Experiments, Wiley Eastern, New Delhi.
2. Gupta, S.P. and Kapoor, V.K. (1978): Fundamentals of Applied Statistics, Sultan Chand & Sons.
3. Panneerselvam, R. (2012): Design and Analysis of Experiments, PHI.

**Reference Books:**

1. Rangaswamy, R (2014). Text book of Agricultural Statistics, New Age publishers
2. Montgomery, D (1972) Design of Experiments, John Wiley and Sons
3. Kempthorne, (1956) Design and Analysis of Experiments, John Wiley. New York.

**Course Outcomes**

1. After studied unit - 1, the student will be able to know the principles of experimental designs.
2. After studied unit - 2, the student will be able to know ANOVA and multiple comparison tests.
3. After studied unit - 3, the student will be able to know various design procedures
4. After studied unit - 4, the student will be able to know missing plot techniques
5. After studied unit - 5, the student will be able to know the concept of factorial experiments.

## PAPER - 11
## STOCHASTIC PROCESSES

**Course Objective(s)**

To enable the students to know the basic concepts of stochastic processes

**UNIT - I**

Basic Concepts: Definition and examples of stochastic process, classification of general stochastic processes into discrete and continuous time, discrete and continuous state spaces, types of stochastic processes, elementary problems.

**UNIT - II**

Markov chains: Definition and examples of Markov chain, Transition Probability Matrix, classification of states, recurrence, simple problems

**UNIT - III**

Basic limit theorem of Markov chain (statement only), stationary probability distribution, applications.

**UNIT - IV**

Continuous Time Markov chain: Pure birth process and Poisson process, Birth and Death process, problems.

**UNIT - V**

Branching process: Definition and examples of discrete time branching process, probability generating function, mean and variance, probability of extinction, simple problems.

**Text Books:**

1. Medhi, J. (1996): Stochastic processes, New Age International (p) Ltd.
2. Karlin, S. and Taylor, H.M. (1975): A first course in Stochastic processes, Academic press.

**Reference Books:**

1. Hoel, P.M.G., Port, S.C. and Stone, C.J. (1991): Introduction to Stochastic processes, Universal Book Stall.
2. Parzen, E. (1962): Stochastic processes, Holden-Day.
3. Cinlar, B. (1975) Introduction to Stochastic processes, Prentice Hall.
4. Adke, S.R. and Manjunath, S.M. (1984): An introduction to Finite Markov Processes, Wiley Eastern.
5. Ross, S.M. (1983): Stochastic processes, John Wiley.

**Course Outcomes**

1. After studied unit-1, the student will be able to know random processes and its classification.
2. After studied unit-2, the student will be able to know Markov chain and its applications.
3. After studied unit-3, the student will be able to know limiting distribution of transition probability
4. After studied unit-4, the student will be able to know Poisson process and its applications
5. After studied unit-5, the student will be able to know the concept of branching processes.

CORE PRACTICAL

**STATISTICAL PRACTICAL-III**

## Course Objective(s)

To enable students to solve problems related to estimation and hypothesis testing, statistical quality control techniques and design and analysis of experiments

Problems relating to the following topics which are covered in Semester V and Semester VI shall form the basis for practical:

1. **Estimation theory** (problems related to estimation of parameters under various methods, confidence intervals for mean, variance and proportions)
2. **Statistical Quality Control** (Control charts for variables and attributes).
3. **Testing of Statistical Hypotheses** (problem related to test of significance of mean, variances, one sample, two samples and more than two samples, Non-parametric tests)
4. **Design and Analysis of Experiments** (problem related to CRD, RBD, LSD, Missing Plot Techniques, Factorial experiments $2^3$, $3^2$ and BIBD)

## Text Books

Books prescribed in the respective core papers shall be used.

## Note

The maximum marks for continuous internal assessment and end semester University examination for Statistical Practical-III shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test (25 marks) and record work (15 marks). The question paper at the end semester examination shall consist of **four questions with internal choice**. A candidate shall attend all the four questions, each of which shall carry 15 marks.

## PROJECT WITH VIVA-VOCE

### Course Objective(s)

To enable students to utilize the theoretical knowledge gained in the core papers and to develop computational and technical skills for real life applications by collecting primary / secondary data and performing analyses and submitting their findings in the form of dissertation / project.

### Note

All the admitted candidates shall have to carry out a project work during the sixth semester under the supervision of the faculty of the Department of Statistics in the College. The core project may be individual / group project (Not exceeding five members in a group). Candidates shall have to submit three copies of the report of the project work at the end of the fourth semester at least two weeks before the last working day and shall have to appear for a viva-voce examination.

The report shall be evaluated and viva-voce examination shall be conducted jointly by an External Examiner and the Project Guide.

The maximum marks for the project report and viva – voce examination shall be fixed as 100, which is split with the following components:

| | | |
|---|---|---|
| Internal Assessment Marks by the Project/Dissertation Guide | : | 25 marks |
| Evaluation of Project/Dissertation Report jointly by the External Examiner and the Guide | : | 50 marks |
| Conduct of Viva-Voce Examination by the external examiner | : | 25 marks |

**INTERNAL ELECTIVE**

**PAPER - 2**

(to choose one out of 2)

**A. MATHEMATICAL ECONOMICS**

## Course Objective(s)

To enable the students to learn mathematical and statistical tools in Economics

### UNIT - I

Scope and methods of Mathematical Economics - Laws of demand , Demand schedule (Individual and Market) - Demand function - Factors influencing the demand - Exception to the law of demand - Elasticity of demand with respect to price and income - Factors affecting the elasticity of demand - Partial elasticity of demand with respect to price - Simple problems in elasticity of demand.

### UNIT - II

Supply - Factors affecting the supply of a commodity - Relation between demand and supply - Utility - Concept of utility - Concept of human wants - Maximization of utility - Marginal and total utility - Law of diminishing marginal utility - Indifference curves and map - Properties of indifference curve - Price line.

### UNIT - III

Cost Analysis - Different types of cost - Total, average and marginal cost functions - Relation between average and marginal costs - Problems related to total, average and marginal costs - Revenue - Total, average and marginal revenue functions and their relationship - Simple problems related to maximization of total revenue

### UNIT - IV

Market Structure - Definition of Market - Perfect completion - Pure competition - Monopolistic competition and duopolistic competition (Only concept) - Profit maximisation - Profit function - Carnot solution to monopoly problem for maximization problem - Joint monopoly and discriminating monopoly - Problems related to profit maximization under monopoly. Duopoly - Conjectural variation and reaction curves - Simple maximization problem under duopoly.

### UNIT - V

Theoretical Production functions - Mathematical definition of production function - Constant product curves (Isoquant) - Average and marginal productivity - Homogenous production functions - Properties of linearly homogeneous production function – Cobb-Douglas production function - C. E. S. production function

**Text Books:**

1. Varma and Agarwal (1998): **Managerial Economics,** Sultan Chand and Company, New Delhi.

2. Mehta and Madhnani (2001): **Mathematics for Economists**, Sultan Chand and Company, New Delhi (Chapters 6, 8, and 9).

**Reference Books:**

1. Allen R.J.D.(1979): Mathematical Economics, Macmillan Press

**Course Outcomes**

1. After studied unit - 1, the student will be able to know basics of mathematical economics
2. After studied unit - 2, the student will be able to know relationship between supply and demand
3. After studied unit - 3, the student will be able to know to execute cost analysis
4. After studied unit - 4, the student will be able to know market structure
5. After studied unit - 5, the student will be able to know production function and its properties

**INTERNAL ELECTIVE**

**PAPER - 2**

**REAL ANALYSIS**

## Course Objective(s)

To enable students to understand the concept of sequence, limits and mean value theorems.

## UNIT - I

Sets: Sets - elements - Operations on set - Functions: Real valued functions equivalence - Countability - Real numbers - Upper and Lower bounds - Supremum and Infemum.

## UNIT - II

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 - III

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

## UNIT - IV

Functions: Limit of real valued functions in one variable, continuity types of discontinuities algebra of continuous functions - Extreme value theorem. Intermediate value theorem - Uniformly Continuous functions

## UNIT - V

Differentiability of Functions - Rolle's theorem - Mean value theorem for derivatives. Taylor s Series expansion - Application to maxima and minima.

**Text Books:**

1. D. Somasundaram and B. Choudhary (2002) : A first course in Mathematical Analysis, Narosa Publishing house.
2. R. R. Goldberg (1970) : Methods of Real Analysis, Oxford & IBH.
3. W. Rudin(1976): Principles of Mathematical Analysis, 3/e, McGraw Hill Company.

**Reference Books:**

1. T. M. Apostol(1985): Mathematical Analysis, Narosa Publishing House.

## Course Outcomes

1. After studied unit - 1, the student will be able to know the concept of set theory and applications
2. After studied unit - 2, the student will be able to know the concept of real numbers and sequences
3. After studied unit - 3, the student will be able to know the concept of series of real number and its convergence and divergence
4. After studied unit - 4, the student will be able to know functions and extreme value theorem and it usage
5. After studied unit - 5, the student will be able to know mean value theorems and its applications

**INTERNAL ELECTIVE**

**PAPER - 3**
**(to choose one out of 2)**

## A. STATISTICAL GENETICS

### Course Objective(s)

To enhance the students apply statistical methods in Genetics

### UNIT - I

Statistics Genetics: Cells, Chromosomes, Gametes, Genes and Gene frequency, Mendel's law - Single locus with two alleles - Hardy-Weinberg equilibrium - A-B-O blood group system, Calculation of Probabilities of offspring blood group for given parental blood group - Chance of incompatibility.

### UNIT - II

Definition of ED50, ED90 etc. - Simple method of estimation of the above. Data: Dose levels (Z,I), number of individuals exposed (n,l), number responding (r,l). Simple regression of probit on log dose to estimate parameters of tolerance distribution.

### UNIT - III

Introduction to logistic regression with binary response and one independent variables (continuous) - Exponential and logistic model of population growth, solving the following differential equations: DNt/dt=kNt, dNt(k-Nt). Fitting the above growth models to data by linearization and regression.

### UNIT - IV

Capture - recapture method of abundance estimation. One and two recapture occasions. Use of likelihood under binomial distribution - Concept of biodiversity. Simpson's and Shannon-Wiener indices.

### UNIT - V

Study of exponential and Weibull distributions as models for survivorship data. Corresponding hazard functions and interpretation of their shapes. Applications to environmental data.

### Text Books:

1. D.J.Finney(1978): Statistical Methods in Biological Assays, Charles Griffics & Co.
2. A.P.Gore and S.A. Paranjpe(2000): A course in Mathematical & Statistical Ecology, Kluwer.

### References Books:

1. R.C. Elandt Johnson (1975): Probability Models and Statistical Methods in Genetics Wiley.

2. C. C. Li (1976): First course in Population Genetics, Boxwood Press.

**Course Outcomes**

1. After studied unit - 1, the student will be able to know the basics of genetics
2. After studied unit - 2, the student will be able to know estimation of parameters using probit models
3. After studied unit - 3, the student will be able to know estimation of parameters using logit models
4. After studied unit - 4, the student will be able to know various computational method indices
5. After studied unit - 5, the student will be able to know applications of exponential and weibull distribution.

**INTERNAL ELECTIVE**
**PAPER - 3**
**ACTUARIAL STATISTICS**

## Course Objective(s)

To impart basic concepts in actuarial studies and to make the students to take up the career in Actuarial Practice

## UNIT - I

Effective Rate of Interest $i$ - Nominal Rate of Interest $i^{(m)}$- Force of Interest $a$ - Relationships between different rates of interest - Expression for $a$ by use of calculus - Present values - Effective rate of discount $d$ - Nominal rate of discount $d^{(m)}$.

## UNIT - II

Annuities - Immediate Annuity - Annuity - due - perpetuity - accumulation and Present values of Annuities - Increasing and Decreasing annuities - Annuities and interest rates with different frequencies - Continuous Annuities.

## UNIT - III

Analysis of Annuity payments - Capital and Interest elements included in the Annuity payments - loan outstanding after t payments - purchase price of Annuities - Annuities involving income tax - Purchase prices of an annuity net of tax.

## UNIT - IV

Stochastic interest rates - Independent annual interest annual interest rates - The definition of $S_n$ - Mean and variance of $S_n$ - Definition of $A_n$ - Mean and variance of $A_n$ - Simple problems.

## UNIT - V

Probabilities of living and dying - The force of mortality $i_x$ - Estimation of $i_x$ - Uniform Distribution of deaths - Select and Ultimate rates.

**Text Books:**

1. Donald, D.W.A.(1975).Compound Interest and Annuities certain. Heinemann, London.
2. Frank Ayres,J.R.(1983).Theory and problems of mathematics of Finance. Schaum's outline series, McGraw hill book company, Singapore.

**Reference Books:**

1. Mc Cutcheon J.J.and Scott.(1989).Mathematics of Finance, Heinemann, London.
2. Neill,A(1977).Life Contingencies, Heinemann, London.

**Course Outcomes**

1. After studied unit - 1, the student will be able to know computation of interest and its variants
2. After studied unit - 2, the student will be able to know computation of annuities
3. After studied unit - 3, the student will be able to know various related features of annuities
4. After studied unit - 4, the student will be able to know computation of stochastic interest rates
5. After studied unit - 5, the student will be able to know computation of mortality

**SKILL BASED SUBJECT**
**PAPER - 4 (PRACTICAL II)**

# STATISTICAL DATA ANALYSIS -II (Software based)

## Course Objective(s)

To enable students to utilize the theoretical knowledge gained in the core papers and to develop computational and technical skills for real life applications emphasizing the importance of statistical software programming.

To compute the various statistical measures using statistical software

1. Tabulation and diagrammatical representation of data.
2. Measures of Central Tendency, Dispersion, Skewness and Kurtosis
3. Correlation and Regression, simple and multiple linear regression.
4. Parametric tests - t-test, F-test, chisquare test.
5. Analysis of variance: One way Classification, Two way Classification.
6. Non-parametric tests: Sign test, Wilcoxon test, Mann-Whitney U test, Median test, Run test, Kolmogorov Smirnov test, Kruskal Wallis test.
7. Statistical Quality control charts for variables
8. Statistical Quality control charts for attributes

## Text Books

Books prescribed in the respective core papers shall be used.

## Note

The maximum marks for continuous internal assessment and end semester University examination for Statistical Data Analysis-II shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test and record work. The question paper at the end semester examination shall consist of **four questions with internal choice**. A candidate shall attend all the four questions, each of which shall carry 15 marks.