

**GOVERNMENT ARTS COLLEGE (Autonomous)**  
**COIMBATORE – 18**  
**DEPARTMENT OF STATISTICS**  
**SCHEME OF EXAMINATION (2015 - 2016 Onwards)**

Sem	Part	Subject	I MM (Hrs)	Exam (Hrs)	Marks					
					SE	CA	Total	SE-Min.	TPM	No. of Credits
I	I	<b>Part - I</b> Language - I: Tamil - I	6	3	75	25	100	30	40	3
	II	<b>Part - II</b> English - I	6	3	75	25	100	30	40	3
	III	<b>Part - III</b> Core - I: Descriptive Statistics	6	3	75	25	100	30	40	4
		Allied - I: Mathematics for Statistics - I	8	3	75	25	100	30	40	5
		Core Practical - I: Statistics Practical - I	2							
	IV	<b>Part - IV</b> Environmental Studies	2	3	75	25	100	30	40	2
II	I	<b>Part - I</b> Language - II: Tamil - II	6	3	75	25	100	30	40	3
	II	<b>Part - II</b> English - II	6	3	75	25	100	30	40	3
	III	<b>Part - III</b> Core - II: Time Series and Index Numbers	6	3	75	25	100	30	40	4
		Allied - II: Mathematics for Statistics - II	8	3	75	25	100	30	40	5
		Core Practical - I: Statistics Practical - I	2	3	60	40	100	24	40	4
	IV	<b>Part - IV</b> Value Education - Gandhian Thoughts	2	3	75	25	100	30	40	2

III	I	<b>Part - I</b> Language - III : Tamil - III	6	3	75	25	100	30	40	3
	II	<b>Part- II</b> English - III	6	3	75	25	100	30	40	3
	III	<b>Part - III</b> Core - III: Probability and Distributions	6	3	75	25	100	30	40	4
		Allied III: C Programming for Statistical Analysis	6	3	75	25	100	30	40	5
		Core Practical - II: Statistics Practical - II	2							
	IV	<b>Part - IV</b> Skill based Elective - I: Demographic Methods	4	3	75	25	100	30	40	3
IV	I	<b>Part - I</b> Language - IV : Tamil - IV	6	3	75	25	100	30	40	3
	II	<b>Part - II</b> English - IV	6	3	75	25	100	30	40	3
	III	<b>Part - III</b> Core - IV:Numerical Analysis	6	3	75	25	100	30	40	4
		Allied - IV: Mathematical Economics	6	3	75	25	100	30	40	5
		Core Practical - II: Statistics Practical - II	2	3	60	40	100	24	40	4
	IV	<b>Part - IV</b> Skill Based Elective - II: Psychological Statistics	4	3	75	25	100	30	40	3
V	<b>Part - V</b> Extention Activities: NSS/NCC/P.Ed/YRC								1	
V	III	<b>Part - III</b> Core - V: Statistical Inference - I	6	3	75	25	100	30	40	4
		Core - VI: Basic Sampling Theory	5	3	75	25	100	30	40	4
		Core - VII: Design of Experiments	5	3	75	25	100	30	40	4
		Core -VIII - AOS: Elements of Operations Research	5	3	75	25	100	30	40	4
		Core Practical - III: Statistics Practical - III	3							
	IV	<b>Part - IV</b> Skill Based Elective - III: Elements of Actuarial Statistics	3	3	75	25	100	30	40	3

		Non - Major Elective - I	3	3	75	25	100	30	40	2
VI	III	<b>Part - III</b> Core - IX: Elements of Econometrics	6	3	75	25	100	30	40	4
		Core - X: Statistical Inference - II	6	3	75	25	100	30	40	4
		Core - XI - AOS: Statistical Quality Control	6	3	75	25	100	30	40	4
		Core Practical - III: Statistics Practical - III	1	3	60	40	100	24	40	4
		Core Practical - IV: Statistics Practical - IV	2	3	60	40	100	24	40	4
		<b>Project &amp; Viva Voce</b>	2	80 (Report)		20 (Viva)	100	32	40	15
	IV	<b>Part - IV</b> Skill based Elective - IV: Optimization Techniques	4	3	75	25	100	30	40	3
		Non - Major Elective - II	3	3	75	25	100	30	40	2
<b>Total</b>			180				<b>3600</b>			<b>140</b>

Statistics - Non - Major Elective:

1. Basic Statistics - I
2. Basic Statistics - II

**Semester I**  
**Core I: DESCRIPTIVE STATISTICS**

**UNIT-I**

Statistics – Definition – Collection of data – Primary and Secondary data – Classification and Tabulation of Data - Formulation of Frequency Distribution - Diagrammatic Presentation and Graphical Representation.

Measures of Central Tendency: Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean – Simple problems.

**UNIT-II**

Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation and Co-efficient of Variation - Lorenz Curve.

Measures of Skewness - Karl-Pearson's Co-efficient of Skewness - Bowley's Co-efficient of Skewness – Kurtosis, Moments - Simple problems.

**UNIT-III**

Correlation: Types of Correlation, Uses and Properties - Scatter Diagram – Karl Pearson Co-efficient of Correlation - Spearman's Rank Correlation - Concurrent Deviation - Concept of Partial and Multiple Correlation.

Regression analysis: Regression Equations – Properties of Regression co-efficients – Uses of regression - Simple problems.

**UNIT-IV**

Probability: Sample Space, Events - Definition of Probability - Independent Events, Conditional Probability - Addition and Multiplication Theorems - Baye's Theorem - Simple problems.

**UNIT-V**

Random Variables – Distribution function – properties (without proof) - Discrete and Continuous Random Variables - Probability Mass Function, Probability Density Function – Mean, Median, Mode, Dispersion and Moments for continuous random variables - Simple Problems.

**Text Books:**

1. S.P.Gupta - Statistical Methods, Sultan Chand & Sons, New Delhi, 42<sup>nd</sup> revised Edition, 2012.
2. S.C.Gupta and V.K.Kapoor - Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 11<sup>th</sup> revised Edition, June 2012.

**Reference Books:**

1. PA. Navaneetham - Business Mathematics and Statistics, Jai Publishers, Trichy, July 2008.
2. B.L.Agarwal - Programmed Statistics, New Age International, Chennai.

**SEMESTER I**  
**ALLIED- I: MATHEMATICS FOR STATISTICS – I**

**UNIT I**

**Set Theory:** Definition – Examples – Venn diagram – Set operations – Laws and properties of sets – Number of elements – Problems (Chapter 3: Sections: 1 – 8).

**UNIT II**

**Matrices:** Definition – Different types of matrices with examples – Matrix operations – Solving system of linear equations – Problems (Chapter 4: Sections: 1 – 7),

**UNIT III**

**Determinants:** Determinants and its properties – Cramers rule - Inverse of a matrix – Rank of matrix - Problems (Chapter 4: Sections 8 – 10).

**UNIT IV**

**Differential Calculus:** Derivatives of standard functions from first principle – Rules of differentiations – Product rule – Quotient rule - Problems (Chapters 6: Sections 1- 4).

**UNIT V**

Chains rule – Differentiation of Implicit functions – Successive differentiation - Problems  
(Chapter 6: Sections: 4 – 8)

**TEXT BOOK:**

**BUSINESS MATHEMATICS AND STATISTICS**, P. A. Navaneetham, Jai Publishers, Trichy, 2008.

**REFERENCE BOOK:**

**ANCILLARY MATHEMATICS**, P. R. Vital, Margam Publishers, Chennai, 1998.

**Semester II**  
**Core II: TIME SERIES AND INDEX NUMBERS**

**UNIT-I**

Time Series: Definition- Components of Time Series - Uses – Additive and Multiplicative Models - Measurement of Trend: Graphical Method, Semi-Average Method, Method of Moving Averages - merits and demerits - Method of Least Squares – Straight lines, Parabolic, Exponential of type  $Y=ab^x$  - Exponential Smoothing - Simple Problems.

**UNIT-II**

Seasonal Variation – Measurement of Seasonal Variations - Method of Simple Averages, Ratio-to-Trend Method, Ratio-to-Moving Average Method and Link Relative Method – Cyclical Variations and Random Variations (Concepts only) - Simple Problems.

**UNIT-III**

Index numbers: Meaning, Definition, Uses and Types - Problems in the Construction of Index Numbers – Un-weighted Index Numbers – Simple aggregative method – Simple average of Price relative method – Limitations of Index Numbers- Simple Problems.

**UNIT-IV**

Weighted Index Numbers – Price Index, Quantity Index, Value Index – Selection of Weights - Average of Price Relatives Method – Laspeyre's Price Index – Paasche's Price Index – Bowley Price Index – Marshall Edgeworth Price Index – Fisher's Index Number- Simple Problems.

**UNIT-V**

Criteria of a Good Index Number -: Unit Test, Time Reversal Test, Factor Reversal Test and Circular Test – Construction of Chain Base Index Numbers -Cost of Living Index Numbers – Its uses – Construction - Aggregate Expenditure and Family Budget Methods - Simple Problems.

**Text Books:**

1. S.C. Gupta and V.K.Kapoor - Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi 4<sup>th</sup> Edition.
2. S.P.Gupta - Statistical Methods, Sultan Chand & Sons, New Delhi, 42<sup>nd</sup> revised Edition, 2012.

**Reference Books:**

1. Croxton and Cowden - Applied General Statistics, Prentice - Hall of India (Private) Ltd, New Delhi.
2. B.L.Agarwal - Programmed Statistics, New Age International, Chennai.

## SEMESTER II

### ALLIED II: MATHEMATICS FOR STATISTICS – II

#### UNIT I

**Integral Calculus:** Infinite integrals – standard forms – Determination of  $c$  – Definite integrals – Problems (Chapter 8: Sections 1 – 4)

#### UNIT II

**Methods of Integration:** Method of Partial fraction – Method of Integration by parts – Problems (Chapters 8: Sections 5 – 8)

#### UNIT III

**Sets and Functions:** Sets and elements – Operation on sets – Functions – Real valued functions – Equivalence, Countability – Problems (Chapter 1: Sections: 1.1 – 1.5).

#### UNIT IV

**Sequences of Real numbers:** Real numbers – Least upper bounds – Sequence – Subsequence – Convergent sequence – Divergent sequence – Bounded sequence – Monotone sequence – Problems (Chapter 1: Sections: 1.6 – 1.7; Chapter 2: Sections: 2.1 – 2.6).

#### UNIT V

**Operations on Sequence:** Operation on convergent sequence- operation on divergent sequence – Limit Superior – Limit inferior (definitions only) Cauchy's sequence– Problems.

(Chapter 2: Sections: 2.7 – 2.10)

#### TEXT BOOK:

1. **BUSINESS MATHEMATICS AND STATISTICS**, Navanitham, P. A, Jai Publisher, Trichy, 2008.(For Units I and II)
2. **METHODS OF REAL ANALYSIS**, Richard R. Goldberg, Oxford and IBH Publishing Company Private Limited, New Delhi, 1970. (For Units III, IV and V)

## **Semester II**

### **Core Practical – I: STATISTICS PRACTICAL - I**

**(Using MS - EXCEL)**

1. Formation of Frequency Distribution - Formation of Charts and Diagrams: Bar Diagrams, Pie Diagram, Frequency Polygon, Frequency Curve, Ogive Curves
2. Calculation of Measures of Central Tendency: Mean, Median, Mode, Geometric Mean, and Harmonic Mean - Calculation of Percentiles.
3. Calculation of Measures of Dispersion: Range, Quartiles, Mean Deviation, Variance, Standard Deviation.
4. Calculation of Skewness and Kurtosis.
5. Scatter Diagram - Calculation of Correlation and Regression Coefficients and Formation of Regression Lines.
6. Problems Related to Curve Fitting - Fitting a Straight Line, Non-Linear Trend Lines and Calculation of Trend Values using Moving Averages.
7. Calculation of Index Numbers – Un-weighted Index numbers, simple aggregative method, simple average of price relative method, Weighted Index numbers – Price and Quantity Index – Laspeyre's, Pasche's, Bowleys, Fisher Ideal price Index numbers. Time Reversal and Factor Reversal test. Chain Base Index and Fixed Base Index numbers.



## Semester III

### Core III: PROBABILITY AND DISTRIBUTIONS

#### UNIT I

Mathematical expectation – definition, properties, Variance and Covariance - Addition and Multiplication theorems (for two variables only) – Moment Generating function - Characteristic function and their properties (without proof) –Tchebyshev's inequality – Weak Law of Large Numbers - Central Limit Theorem (Concept only)

#### UNIT II

Bivariate Distribution: Concepts of Bivariate, Marginal and Conditional Distributions – Independence of Random Variables. Marginal and Conditional Expectations, Conditional Variance.

#### UNIT III

Discrete Distributions – Bernoulli, Binomial, Poisson and Geometric Distributions – Definition – moments - MGF- Recurrence relations – additive property – limiting cases (statement only).

#### UNIT IV

Continuous distributions – rectangular, Normal, Exponential, Beta (first and second kind) and Gamma distributions – Definition – moments – MGF- additive property - limiting cases (statement only)

#### UNIT V

Definition – Application and Derivation of  $t$ ,  $F$  and Chi-square distributions – MGF- additive property – Mean and variance- relationship between  $t$ ,  $F$  and Chi-Square distributions (no other constants).

#### Text Books:

1. S.C.Gupta and V.K.Kapoor - Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 11<sup>th</sup> revised Edition, June 2012.
2. R.V.Hogg and A.G Craig - Introduction to Mathematical Statistics, Amerind.

#### Reference Book:

1. J.N. Kapoor and H.C. Sexana - Mathematical Statistics, Sultan Chand & Sons, New Delhi.

**Semester III**  
**Allied III: C - PROGRAMMING FOR STATISTICAL ANALYSIS**

**UNIT I**

Overview of C: Introduction to C – Importance of C – Structure of C Program – Programming Style – Executing a C Program – Constants, Variables and Data Types: Character Set – C Tokens – Keywords and Identifiers – Constants – Variables – Data Types – Declaration of Variables – Assigning Values to Variables – Symbolic Constants.

**UNIT II**

Operators and Expression: Arithmetic Operator – Relational Operators – Logical Operators – Assignment Operators – Conditional Operators – Increment and Decrement Operators – Library Function. Managing Input and Output Statements: Single Character Input- getchar() function – putchar() function- scanf() function – output functions: printf() function – gets() and puts() function.

**UNIT III**

Decision Making and Branching: Decision making with if statement – simple if statement – if – else statement – Nesting if-else statement – switch statement – break – continue statement – Looping and Branching using while statement – do-while statement – for loop statement – its syntax and simple examples.

**UNIT IV**

Arrays: One Dimensional Arrays – Declaration - Initialization –two Dimensional arrays – syntax – initialization – Simple Programs to find Mean – Median – Standard Deviation – Correlations. – Character arrays and Strings – Declaration Syntax – Initialization – Reading Strings from the Keyboard – Output of the Strings using Printf() – String functions – strcat() – strcmp() – strlen().

**UNIT V**

User Defined Functions – Need – Multi-function program – Elements of User Defined Functions – Definition of Functions – Function Calls – Return Types – Declaration – Category of Functions- Function program to sort an array of integers.

**Text Book:**

1. E. Balagurusamy- Programming in ANSI , Tata McGraw-Hill, New Delhi.

**Reference Book:**

1. Herbert Schildt - The Complete Reference

## Semester III

### Skilled Based Elective-I: DEMOGRAPHIC METHODS

#### UNIT-I

Demography: Definition – Sources of Demographic data - Vital Registration - Population Census -Population Register - Demographic Surveys - Population data as an aid to Social, Economic and Health Planning - Simple Problems.

#### UNIT-II

Fertility measurements: Rates and Ratios –Fertility – Factors affecting fertility – Fertility Measures - Crude Birth Rate (CBR), General, Specific and Total Fertility Rates – Growth Rates- Gross and Net Reproduction Rates (GRR, NRR) - Simple Problems.

#### UNIT III

Mortality Measurements: Mortality – Mortality Measures - Crude Death Rate (CDR), Age, Sex and Cause Specific Death Rates - Standardized Death Rate - Infant Mortality Rate - - Simple Problems

#### UNIT IV

Life Table: Assumptions, Description of various columns of a Life table and their relationships - Construction of a Life table - Uses of a Life table - Simple Problems

#### UNIT V

Migration: Definition - Factors affecting Migration - Gross and Net Migration Rates - Projection : Population estimates and Projection – Arithmetic, Geometric and Exponential Growth Rates - Basic ideas of Stationary and Stable population - Simple Problems

#### Text Books:

1. Goon. A.M, Guptha.M.K and Das Guptha - Fundamentals of Statistics Vol.II (world press) Gupta.S.C and Kapoor.V.K - Fundamentals of Applied Statistics, S.Chand &Co, 4<sup>th</sup> thoroughly revised edition, New Delhi, Reprint 2009.
2. S.C. Gupta and V.K.Kapoor - Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.

#### Reference Book:

1. Mishra D.E - An introduction to the study of population (South India publishers, Madras)
2. Jhingan M.L, Bhatt B.K and Desai J.N. - Demography, Vrinda Publications (P) Ltd, Delhi, 2003 2<sup>nd</sup> Revised Edition

**Semester IV**  
**Core IV: NUMERICAL ANALYSIS**

**UNIT I**

Finite Differences - Operators – Forward and Backward Difference Operators – Operator E and their basic Properties (without proof) - Interpolation with Equal Intervals - Newton's Forward and Backward Differences Formulae – Simple Problems – Equidistant Terms with One or More Missing Values .

**UNIT II**

Central Difference Interpolation Formula – Gauss Forward Interpolation Formula – Gauss Backward Interpolation Formula – Stirling's Formula – Bessel's formula – Simple problems.

**UNIT III**

Interpolation with unequal intervals – Divided Difference and their properties (without proof) – Newton Divided Difference Formula – Lagrange's Formula –simple problems – Inverse Interpolation using Lagrange's formula.

**UNIT IV**

Numerical Differentiation - Newton's Forward and Newton's Backward Difference Formula to Compute the Derivative – Derivative using Stirlings Formula (Upto Second Order Only).

**UNIT V**

Numerical Integration: Trapezoidal Rule, Simpson's  $1/3^{\text{rd}}$  and  $3/8^{\text{th}}$  Rules - Numerical Method of Solution of Ordinary Differential Equations - Taylor's Series Method - Euler Method and Runge - Kutta Method upto Second Order - Simple Problems Only.

75% Problems and 25% Theory

**Text Books:**

1. P.Kandasamy, K.Thilagavathy, K.Gunavathi - Numerical Methods , S.Chand Company Ltd, New Delhi.
2. S.S. Sastry - Numerical Analysis, PHI Learning Pvt. Ltd, New Delhi.

**Reference Book:**

1. G.Shanker Rao - Numerical Analysis, New Age International (P) Ltd, Publishers, New Delhi

## **Semester IV**

### **Allied IV: MATHEMATICAL ECONOMICS**

#### **UNIT – I**

Introduction to Economics and Economic Laws – Scope of Mathematical Methods in Economics – Theory of Demand – Demand Function – Demand Curve – Elasticity of Demand – Revenue Function – Average and Marginal Revenue – Normal Conditions of Demand.

#### **UNIT – II**

Consumer's Equilibrium – Utility Approach to Consumer's Equilibrium – Limitation – Scale of Preference – Indifference Curve Approach – Income and Substitution Effects.

#### **UNIT – III**

Cost Function and Cost Curves – Average and Marginal Cost Curves – Cost Elasticity and Normal Cost Conditions – Short Term and Long Term Cost Curves.

#### **UNIT – IV**

Concept of Market Equilibrium – Input and Output Models – Fixation under Perfect Competition – Monopoly – Discriminating Monopoly.

#### **UNIT – V**

Production Function – Constant Product Curves – Laws of Returns and Returns to Scale. Marginal Rates of Substitution – Expansion Path – Elasticity of Substitution.

#### **Text Books:**

1. Agarwal - Mathematics Approach to Economics
2. R.G.D Allen - Mathematical Analysis for Economists, Macmillan.

#### **Reference Books:**

1. Mehtha and Madhamani - Mathematics for Economics
2. Goel and Saxena - Mathematics for Economics

**Semester IV**

**Core Practical – II: STATISTICS PRACTICAL - II (Using C)**

1. C program to find Factorial of N Numbers.
2. C program to Arrange Data in Ascending Order Using Bubble Sort.
3. C program to find the Value of Mean and Standard Deviation.
4. C program to Calculate Correlation Coefficient.
5. C program to Calculate Individual and Cumulative Probabilities of Binomial Distribution.
6. C program to Calculate Individual and Cumulative Probabilities of Poisson Distribution.
7. C program to interpolate by using Newton Forward Interpolation formula.
8. C program to Calculate Laspeyre's, Paasche's and Fisher's Index Numbers.
9. C program to Calculate Seasonal Index by the Method of Simple Averages.
10. C program to fit a Linear Model by the Method of Least Squares.

## Semester IV

### Skill Based Elective-II: PSYCHOLOGICAL STATISTICS

#### UNIT I

Introduction-scaling procedures-  $Z$  or  $\sigma$  scores-standard scores-Normalized scores- T-scores- Percentile score-Scaling of rankings in terms of Normal Probability curve-scaling of ratings in terms of Normal Probability curve

#### UNIT II

Reliability of test scores- definition of reliability- index of reliability- Parallel tests- Methods for determining test reliability- the test-retest method- Alternate or parallel forms method- split half method- effect of test length on the reliability of the test- effect of different ranges on the reliability of the test – Cronbach's alpha.

#### UNIT III

Estimation of validity- types of validity- validity and test length- comparison between reliability and validity- Intelligence tests- Mental age- Intelligence quotient

#### UNIT IV

Biserial correlation- correlation from fourfold tables- the contingency coefficient- curvilinear relationship

#### UNIT V

Correlation ration- intra-class correlation- partial and multiple correlation- definition- formula for three variables- limitations- simple problems

#### Text Books:

1. S.C.Gupta and V.K.Kapoor - Fundamentals of Applied Statistics, Sultan Chand and Sons, 4<sup>th</sup> thoroughly revised edition, New Delhi, Reprint 2009.
2. H.E.Garrett - Statistics in Psychology and Education , International Book Bureau.

#### Reference Book:

1. S.C.Gupta& V.K.Kapoor - Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 11<sup>th</sup> Revised Edition, June 2012.

## Semester V

### Core V: STATISTICAL INFERENCE - I

#### UNIT I

Basic Concepts - Population, Sample, Statistic, Parameter - Point estimation: Meaning – Characteristics of Estimators – Unbiasedness – Simple Problems.

#### UNIT II

Minimum Variance Unbiased Estimators – Cramer Rao Inequality- MVB estimator – Consistency – Sufficient Conditions for Consistency– Simple Problems.

#### UNIT III

Efficiency – Most Efficient Estimator. Sufficiency - Neymann's Factorization Theorem - Rao Blackwell Theorem – Simple Problems.

#### UNIT IV

Methods of Estimation: Method of Maximum Likelihood - Properties of MLE (Without Proof) - Methods of Moments – Simple Problems.

#### UNIT V

Interval estimation: Sampling Distribution and Standard Error - Confidence Intervals - Derivation of Confidence Intervals for Proportion, Mean and Variance Based on Normal,  $t$ ,  $\chi^2$  and F Distributions – Simple Problems.

#### Text Books:

1. S.C. Gupta and V.K. Kapoor - Fundamentals of Mathematical Statistics , Sultan Chand & Sons, New Delhi, 11<sup>th</sup> Revised Edition, June 2012.
2. Goon ,A.M., Gupta,M.K & Das Gupta,B - An Outline of Statistical Theory V-II, The World Press Kolkatta, (1989).

#### Reference Books:

1. G. W. Snedecor and W.G. Cochran - Statistical Methods.
2. P.G. Hoel - Introduction to Mathematical Statistics, Wiley International.



## Semester V

### Core VI: BASIC SAMPLING THEORY

#### UNIT I

Concept of Sampling and Population – Need for Sampling – Design, Organization and Execution of Sample Survey – Principal Steps in Sample Surveys – Preparation of Questionnaire and Schedules – Pilot Survey – Sampling and Non-Sampling Errors – Limitations of Sampling.

#### UNIT II

Sampling from Finite Population – Simple Random Sampling With and Without Replacement – Unbiased Estimate of Mean and Variance – Finite Population Correction – Estimation of Standard Error from a Sample – Simple Random Sampling of Attributes – Estimation of Sample Size.

#### UNIT III

Stratified Random Sampling: Concept of Stratifying Factor - Unbiased Estimate of the Mean and Variance of the Estimated Mean – Proportional and Optimum Allocation – Neyman's Allocation - Comparison of Stratified and Simple Random Sampling.

#### UNIT IV

Systematic Sampling: Estimation of the Mean and Variance – Comparison of Simple, Stratified and Systematic Sampling – Population with Linear Trend - Circular Systematic Sampling.

#### UNIT V

Cluster Sampling - Two Stage Sampling with respect to Simple Random Sampling – Unbiased Estimator of the Mean and Population Variance.

#### Text Books:

1. W.G. Cochran - Sampling Techniques, Wiley India (P)Limited, New Delhi, 2011
2. S.C. Gupta and V.K. Kapoor - Fundamental of Applied Statistics , Sultan Chand & Sons, New Delhi , 2007.

#### Reference Books:

1. P.V. Sukathme and B.V. Sukathme - Sampling theory of survey with applications, Asia Publishing House.
2. Daroga singh, F.S.Chauwdhary – Theory and Analysis of sample survey designs, New Age International (P) Ltd, publishers, New Delhi, 2002.

## Semester V

### Core VII: DESIGN OF EXPERIMENTS

#### UNIT I

Analysis of Variance (ANOVA): Definition – Assumptions – Importance – Linear Models – Fixed Effect Model – Random Effect Model – One-way ANOVA for Fixed Effect Model – Least Square Estimates of Parameters – Variance of the Estimates – Two-way ANOVA for Fixed Effect Model - Least Square Estimates of Parameters.

#### UNIT II

Fundamentals of Design of Experiments – Phases of Experimentation – Experimental Error – Uniformity Trials – Principles of Experimental Design – Size and Shape of the Plots – Concept of Completely Randomized Design (CRD) - Layout - Statistical Analysis.

#### UNIT III

Concept of Randomized Block Design (RBD) – Layout – Statistical Analysis – Advantages and Disadvantages – Efficiency of RBD over CRD – Estimation of one Missing Values.

#### UNIT IV

Concept of Latin Square Design (LSD) - Layout – Advantages and Disadvantages – Statistical Analysis – Least Square Estimates – Estimation of one Missing Values.

#### UNIT V

Factorial Experiments – advantages –  $2^2$  Factorial Design – Statistical Analysis of  $2^2$  Design – Yates method of Computing Factorial Totals –  $2^3$  Factorial Design - Statistical Analysis of  $2^3$  Design – Confounding (Concept only).

#### Text Books:

1. Gupta S.C and Kapoor V.K - Fundamental of Applied Statistics, Sultan Chand & Sons, New Delhi, 4<sup>th</sup> thoroughly revised edition, New Delhi, Reprint 2009.
2. W.G.Cochran and G.M. Cox - Experimental Designs, John Wiley.

#### Reference Book:

1. Montgomery - Design and Analysis of Experiments, Wiley India Pvt. Ltd, 5<sup>th</sup> Edition, Reprint 2009.

**Semester V**  
**Core VIII: AOS - ELEMENTS OF OPERATIONS RESEARCH**

**UNIT I**

Definition and Scope of Operations Research – Uses and Limitations of Operations Research – Models in Operations Research – Phases of Operations Research - Linear Programming Problem – Formulation of LPP – Solution by Graphical Method.

**UNIT II**

Canonical and Standard Form of LPP – Maximization and Minimization Problems – Simplex Method – Big M Method - Duality in LPP – Formulation of Dual LPP (Concept Only – No Problems in Duality).

**UNIT III**

Transportation Problem – Balanced and Unbalanced Transportation Problem – Initial Basic Feasible Solution – North West Corner Rule, Least Cost Method, Vogel's Approximation Method – Optimum Solution – MODI Method.

**UNIT IV**

Assignment Problem – Balanced and Unbalanced Assignment Problem – Maximization and Minimization Problems – Hungarian Method – Travelling Salesman Problem.

**UNIT V**

Inventory Control –Types – Reasons – Costs involved in Inventory – Lead Time – Reorder Level –EOQ – Purchasing and Manufacturing Models with No Shortages – ABC and VED analysis (concept only).

**Text Books:**

1. Kanti Swarup, P.K. Gupta and Manmohan - Operations Research (1980), Sultan Chand & Sons, New Delhi.
2. J.K. Sharma - Operations Research -Theory & Applications (2007), Macmillan India Ltd, Third Edition, 2007.

**Reference Books:**

1. V.K.Kapoor - Problems in Operations Research, Sultan Chand & Sons, New Delhi.
2. Prof. V.Sundaresan, K.S. Ganapathy, Subramanian, K.Ganesan - Resource Management Techniques (2000), A.R. Publications, Tamil Nadu, New Revised Edition, June 2000.

## Semester V

### Skill Based Elective -III: ELEMENTS OF ACTUARIAL STATISTICS

#### UNIT – I

Principles of Life Assurance: Nature of Insurance – Classification of Insurance – History of Life Insurance in India.

#### UNIT – II

Basic Concepts of Mathematics of Finance – Elements of Simple Interest – Elements of Compound Interest – Effective and Nominal Rates of Interest – Depreciation.

#### UNIT – III

Annuities – Present Value of Immediate Annuity- Present value of Immediate Annuity Certain – Accumulated value of Annuity- Present Value of Deferred Annuity Certain-Accumulated value of a Deferred Annuity Certain.

#### UNIT – IV

Premiums: General Principles – Natural Premiums – Level Premiums – Office Premiums with Profit and Without Profit Premiums – Adequacy of Premiums.

#### UNIT – V

Legal Environment – Motor Vehicles Act- Hit & Run Accidents Act- Public Liability Insurance Act- Marine Insurance ACT- Carriage of Goods by Sea Act- Merchant Shipping Act- Indian Railway Act- Indian Post Office Act- Carriage by Air Act- Consumer Protection Act- Indian Information Technology Act .

#### Text Books:

1. Insurance Institute of India - Mathematical Basis of Life Assurance.
2. Insurance Institute of India - Insurance Business Environment. IC-12

#### Reference Books:

1. PA. Navaneetham - Business Mathematics and Statistics, Jai Publishers, Trichy
2. CT-5 General Insurance, Life and Health Contingencies – Institute of Actuaries of India.

## **Semester VI**

### **Core IX: ELEMENTS OF ECONOMETRICS**

#### **UNIT I**

Econometrics – Origin, Definition, Objectives, Characteristics and Scope of Econometrics – Limitations of Econometrics – Models in Econometrics.

#### **UNIT II**

Simple linear regression model - Error Term in Econometric Models - Statistical Assumptions in Linear Model - Least Square Estimation- Properties of Least Square Estimation - Testing of Parameters of the Model - Estimation of Error Variance - Simple Problems.

#### **UNIT III**

General Linear Model - Assumptions- Least Square Method of Estimation - Testing of the Parameters of the model - Gauss-Markov Theorem.

#### **UNIT IV**

Multicollinearity - Meaning- Causes of Multicollinearity- Effects of Multicollinearity - Autocorrelation- Sources of Autocorrelation - Durbin-Watson Test - Dummy Variables (Concept Only) - Uses of Dummy Variables - Specification Errors.

#### **UNIT V**

Econometric Models in Planning - Mahalanobis Four Sector Model – Introduction - calculation of net investment - income and employment generated - summary of the model - Criticism of the Model.

#### **Text Books:**

1. K.Dhanasekaran - Econometrics (II<sup>nd</sup> Edition), Vrinda Publications (P) Ltd, Delhi-91(2011).
2. S.P.Singh, AnilK - Econometrics and Mathematical Economics, Parashar & H.P.Singh,S.Chand & Company Ltd, New delhi-110 055, seventh Edition, (1999)

#### **Reference Book:**

1. A. Koutsoyannis - Theory of Econometrics, PALGRAVE, Replica Press Pvt. Ltd, India, second edition, Reprint 2004.

## Semester VI

### Core X: STATISTICAL INFERENCE – II

#### UNIT I

Testing of Hypothesis - Statistical Hypothesis - Simple and Composite Hypothesis, Null and Alternative Hypothesis - Two Types of Errors-Critical Region-Power of a Test - Neyman-Pearson Lemma.

#### UNIT II

Most Powerful Test - Uniformly Most Powerful Tests - Simple Problems - Tests Based on Student's - t, Chi-Square, F and Normal Distributions (Without Proof) - Likelihood Ratio Criterion - Definition and Test for Mean and Variance (One Sample Only).

#### UNIT III

Tests of Significance - Large Sample Tests - Z-Test For Single Mean, Two Means and Single SD. Small Sample Tests - t-test for Single Mean, Two Means, Paired t-test - Correlation Co-Efficient and Partial correlation Co-Efficient.

#### UNIT IV

F-test for Two Variances – Multiple correlation - Chi-Square Test – Contingency Tables – Test for Goodness of Fit and Independence of Attributes.

#### UNIT V

Non-Parametric Tests: Run Test, Median Test and Mann-Whitney 'U' Test (One Sample and Two Sample Problems) - Kolmogorov's Smirnov One Sample Test (Without Proof)- Kruskal Wallis Test – simple problems.

#### Text Books:

1. S.C. Gupta, and V.K.Kapoor - Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 11<sup>th</sup> Revised Edition, June 2012.
2. M. Rajagopal and P. Dhanavanthan – Statistical Inference, PHI Learning Private limited, New Delhi, 2012 Eastern Economy Edition.

#### Reference Books:

1. Lehmann, E.L - Testing statistical Hypothesis (2<sup>nd</sup> Edition) , (1986), Springer New York.
2. C.W. Snedecor, and W.G.Cochran - Statistical Methods, Oxford and IBH

## Semester VI

### Core XI: AOS - STATISTICAL QUALITY CONTROL

#### UNIT I

Basic concepts of quality – Meaning of quality – Quality of design – Quality of conformance – Quality of performance - Statistical Quality Control – Meaning – Basic concepts of SQC – Uses – Causes of variation.

#### UNIT II

Process control - Control Charts – 3 Sigma Limits – Uses of control charts - Control Charts for Variables –  $\bar{x}$  and R Charts – Control Charts for Attributes – p, np and c Charts (for fixed and varying sample size) – Comparison of attribute and variable control charts - Simple Problems.

#### UNIT III

Product Control - Acceptance Sampling – Meaning – Applications in Industry Producer's Risk and Consumer's Risk - Definitions of AQL, LQL, IQL, AOQL, ASN and ATI - Measures of performance - Concept of OC Function - Type A and Type B OC curves – OC Functions Based on Hypergeometric, Binomial and Poisson distributions.

#### UNIT IV

Attribute Sampling Plans – Single and Double Sampling Plans - Conditions of Applications – Operating Procedures – OC, ASN, AOQ and ATI functions - Evaluation of Measures of Performance of SSP and DSP.

#### UNIT V

Multiple Sampling Plan for Attributes - Concept - Operating Procedure – Comparison of Single, Double and Multiple Sampling Plans - Sequential Sampling Plan for Attributes – Wald's Sequential Probability Ratio Test – OC Curve – Five Points OC Curve – Five Points ASN - Advantages.

#### Text Books:

1. Gupta S.C and Kapoor V.K - Fundamentals of Applied Statistics Sultan Chand & Sons, New Delhi, 4<sup>th</sup> thoroughly revised edition, New Delhi, Reprint 2009.
2. Duncan A.J - Quality Control and Industrial Statistics, Irwin Homewood.

#### Reference Books:

1. Grant E.L and Leaven Worth R.S - Statistical Quality Control, McGraw Hill, New York.
2. Mahajan M., - Statistical Quality Control Dhanpat Rai & Co (P) Ltd, Delhi, 2009.

## Semester VI

### Skill Based Elective - IV: OPTIMIZATION TECHNIQUES

#### UNIT I

Game Theory – Introduction – Two-Person Zero-Sum Games – Concept of Pure and Mixed Strategies – Games With and Without Saddle Points – Solving  $2 \times 2$  Games – Dominance Property – Graphic Solution of  $2 \times n$  and  $m \times 2$  Games.

#### UNIT II

Network analysis – Basic Concepts – Construction of Network – Critical Path Method (CPM) – Floats – Program Evaluation and Review Technique (PERT) – Difference between CPM and PERT – Resource allocation and scheduling (Concept only).

#### UNIT III

Replacement Problems – Introduction – Replacement of Items that Deteriorates Gradually (Value of Money Does Not Change With Time and Changes With Time) – Replacement of Items that Fails Suddenly – Individual and Group Replacement.

#### UNIT IV

Queuing Theory: Introduction – Characteristics of Queuing Models – Classification of Queues – Problems from Single Server: Infinite Population Model.

#### UNIT V

Sequencing Problem – Problems with  $n$ - jobs Through Two Machines – Problems with  $n$ - jobs on Three Machines – Idle Times and Total Elapsed Time Calculations.

#### Text Books:

1. Kanti Swarup, P.K. Gupta and Manmohan - Operations Research, Sultan Chand & Sons, New Delhi, 14<sup>th</sup> edition, 2008 .
2. V.Sundaresan, K.S. Ganapathy Subramanian, K.Ganesan - Resource Management Techniques, A.R. Publications, Tamil Nadu, New Revised Edition, June 2000.

#### Reference Book:

1. J.K. Sharma - Operations Research -Theory & Applications, Macmillan India Ltd, Third Edition, 2007.



## Semester VI

### Core Practical – III: STATISTICS PRACTICAL - III

#### 1. Statistical Inference

- Estimation of Parameters of Distribution by the Method of Moments and Maximum Likelihood with regard to Discrete and Continuous Distribution.
- Test of Significance- Large Sample Tests-Single Mean – Difference of Means. Small sample tests – Paired t-test – F-test – Ratio of Two Variances.
- Chi – Square Test - Independence Test and Goodness of Fit.
- Non – Parametric Tests – Median Test, Run Test, Mann-Whitney Test, Kruskal Wallis Test, Kolmogorov Smirnov Test.

#### 2. Design of Experiments :

- Analysis of CRD, RBD and LSD Layouts.
- Missing Plot Techniques in RBD and LSD.
- Analysis of  $2^2$  and  $2^3$  Factorial Experiments.

#### 3. Basic Sampling Theory :

- Estimation of Mean and Variance of The Population - The Variance of the Estimator of the Mean Using Simple Random Sampling Procedure.
- Stratified Random Sampling, Estimation of the Mean And Variance of the Population and of the Variance of the Estimation of the Mean Under Proportional and Optimum Allocation.
- Systematic Sampling.

#### 4. Elements of Econometrics

- Simple and Multiple Regression –Estimation of Regression Coefficient and Error Variance-Linear Prediction.
- Tests of Significance of Regression Coefficients.
- Estimating Serial Correlation and Testing –Durbin-Watson Test.

#### 5. Statistical Quality Control

- Control Charts for Attributes and Variables:  $\bar{x}$ , R, p, np and c charts.
- Single Sampling Attributes Plan : OC, ASN, ATI, AOQ Curves.

## **SEMESTER - VI**

### **Core Practical – IV: STATISTICS PRACTICAL – IV (USING STATISTICAL SOFTWARE PACKAGE)**

#### **UNIT I**

Essential terminology for all SPSS users-getting to SPSS for windows - the components of window - SPSS for windows screens – crucial preliminaries-entering data into SPSS-editing data-saving data file-retrieving data file.

#### **Unit II**

Merging data files –adding scores to existing cases –add variables – running Mean,Median,Range, Standard Deviation, Variance, Skewness, Kurtosis and obtaining the output.

#### **Unit-III**

Checking the data –Box plots of score distributions –listing of the data using case summaries – graphs –bar, line, pie chart, scatter plots and histograms.

#### **Unit IV**

Frequency distribution-measures of frequency distributions-cross tabulations – obtaining two sample chi-square tests-log linear analysis –parametric statistical tests –comparing means-Independent and paired t-tests

#### **Unit V**

Correlation and multiple regression-analysis-non parametric analysis- Wilcoxon, mann-whitney, Kruskal Wallis tests –ANOVA: one way

## **Semester V**

### **Non-Major Elective I: BASIC STATISTICS – I**

#### **UNIT – I**

Statistics – Introduction – Definition, Origin, Scope and Limitations of Statistics – Collection of data – Primary and Secondary data – Classification and Tabulation of Data- Formulation of Frequency Distribution - Diagrammatic and Graphical Representation.

#### **UNIT – II**

Measures of Central Tendency: Requisites of a good average - Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean.

#### **UNIT – III**

Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation and Co-efficient of Variation.

#### **Unit – IV**

Skewness : Measures of Skewness - Karl-Pearson's Co-efficient of Skewness - Bowley's Co-efficient of Skewness, Kurtosis (Concept only).

#### **Unit V**

Probability – Definition - Mutually Exclusive and Independent Events – Addition Theorem – Multiplication Theorem - Simple Problems.

#### **Text Book:**

1. P.A. Navanitham - Business Mathematics and Statistics, Jai Publishers, Trichy, July 2008.

#### **Reference Book:**

1.S.P. Gupta - Statistical Methods,Sultan Chand & Sons, New Delhi, 42<sup>nd</sup> revised Edition,2012.

## **Semester VI**

### **Non-Major Elective II: BASIC STATISTICS – II**

#### **UNIT I**

Correlation – Meaning – Scatter diagram – Karl Pearson’s Correlation Coefficient – Merits and Demerits - Simple Problems.

#### **UNIT II**

Rank Correlation – Spearman’s Rank Correlation Coefficient – Merits and Demerits – Concurrent Deviation Method – Simple Problems.

#### **UNIT III**

Regression – Uses - Regression Equations – Properties - Simple Problems.

#### **UNIT IV**

Time series – Uses – Components of Time Series – Measurement of Trend –Graphical method- Semi Average Method - Moving Average Methods – Simple Problems.

#### **UNIT V**

Index Numbers – Uses – Characteristics - Construction of Weighted Index Numbers – Laspeyre’s, Paasches and Fisher’s Index Numbers – Cost of Living Index - Simple Problems.

#### **Text Book:**

1. P.A. Navaneetham - Business Mathematics and Statistics, Jai Publishers, Trichy.

#### **Reference Book:**

1. S.P. Gupta - Statistical Methods, Sultan Chand & Sons, New Delhi.