

# **NATIONAL COLLEGE (AUTONOMOUS)**

*Nationally Re-Accredited with 'A+' Grade by NAAC*

*(Affiliated to Bharathidasan University)*

TIRUCHIRAPPALLI – 620 001



**Estd. 1919**

## **DEPARTMENT OF STATISTICS**

### **B.Sc., STATISTICS**

### **SYLLABUS**

**2022 - 2023 Onwards**

**VISION:** To make students a great statistician, creating employment upon completion of the course, preparing students for competitive examinations.

**MISSION:** We strive to develop students into outstanding experts in statistics.

**OBJECTIVES:** Statistics is a science which deals with data arise from various phenomena. Statistics plays an important role in almost all the disciplines of sociological and Biological Sciences, Economics, Computer Science and Information Technology. The main objective of the course is to make students to learn the fundamental principles, the scope of Statistics, to understand the theoretical basis of various realms of Statistical methods and to train the students in the application of various analytical tools in solving the real life problems.

**LEARNING OUTCOMES:**

- ❖ Able to understand and apply the concepts of statistics and various statistical tools in different areas of its application and hence able to solve a wide range of problems associated with Statistics.
- ❖ Able to conduct statistical surveys and experimental studies and to demonstrate data analysis together with proper and effective interpretations.
- ❖ Able to handle statistical packages for practical utility and also able to develop new software programs in accordance with the requirements for solving a problem.

**CARRIER IN STATISTICS:** After the completion of undergraduate (B.Sc. Statistics) course, students can pursue higher education in the field of statistics, professional courses and research level studies.

<b>Postgraduates</b>		<b>Professional Courses</b>
M. Sc. Statistics	M. Sc. Bio-Statistics	M.B.A
M. Sc. Statistics with Computer Applications	M. Sc. Demography	M.C.A.
M. Sc. Data Science / Data Analytics	M. Sc. Quantitative Economics	C.A
M. Sc. Operations Research	M. Sc. Business Analytics	F.R.M.
M. Sc. Information Technology	M. Sc. Computer Science	C.F.A.
M. Stat	M.Sc. Applied Data Science	C.C.A.
M. Pharm.	M.Sc. Big Data Analytics	I.C.W.A.

<b>Job Opportunities</b>	
Statistical Investigator (TNPSC)	Bio-Statistician
Block Health Statistician (TNPSC)	Data Scientist
Statistician	Data Analyst
Young professional (Statistics) in MOSPI	Actuarial Analyst
Agriculture Statistical Officer	Operational Researcher
Field Officer (Statistics)	Market Researcher
Statistics Subject Matter Expert	Meteorologist

## **Programme Outcomes – (PO)**

At the completion of the Undergraduate Programme, the student will be able to accomplish the following outcomes:

<b>PO No.</b>	<b>Programme Outcomes</b>	<b>Graduate Attributes</b>
<b>PO1</b>	Integrate a strong foundation in statistics	Disciplinary Knowledge
<b>PO2</b>	Develop language skills by helping them express their ideas and views clearly and effectively and Assist students in understanding the statistical skills and develop their ability to work both independently and in groups.	Communication Skills
<b>PO3</b>	Identify and apply appropriate principles and methodologies to solve a wide range of problems associated with statistics	Critical Thinking and Problem Solving
<b>PO4</b>	Help students do research projects and apply them for the upliftment for their career and gain proficiency in using statistical software for data analysis	Analytical Reasoning and Technology Competency
<b>PO5</b>	Involve students in various activities thereby help them apply the moral and ethical standards of statistics in their career.	Moral and Ethical Awareness
<b>PO6</b>	To make them familiar with the modern concepts in statistics and engage them in Self-regulating and life-long learning in the broadest perspective of hi-tech change	Self Directed and Lifelong Learning

## **Programme Specific Outcomes – (PSO)**

At the completion of the Undergraduate Programme, the student will be able to accomplish the following outcomes:

<b>PSO No.</b>	<b>Programme Specific Outcomes</b>
<b>PSO1</b>	Understand how to collect, classify, analyze, compile and interpret the data
<b>PSO2</b>	Ability to analyze the data by using Microsoft Excel, R-Programming, C-Programming and SPSS Software
<b>PSO3</b>	Motivate students to pursue career in related disciplines, especially the Statistics, Bio-Statistics, Data Science and Actuarial Science

## **KNOWLEDGE LEVEL – (KL)**

**K1:** Remember    **K2:** Understand    **K3:** Apply    **K4:** Analyze    **K5:** Evaluate    **K6:** Create

**B.Sc. STATISTICS SYLLABUS (2022 – 2023 ONWARDS)**

Semester	Part	Sub. Code	Course	Hrs.	Credits	Int.	Ext.	Total
I	I	U22T1 / U22H1 / U22S1	Tamil – I / Hindi – I / Sanskrit – I	6	3	25	75	100
	II	U22E1	English – I	6	3	25	75	100
	III	U22ST1	Descriptive Statistics	5	5	25	75	100
		U22ST2P	Practical – I(Non-Sitting)	3	-			
		U22AMST1	Mathematics – I	5	5	25	75	100
		U22AMST2P	Mathematics – II(Non-Sitting)	3	-			
	IV	U22ES	Environmental Science	2	2	25	75	100
			<b>30</b>	<b>18</b>				
II	I	U22T2 / U22H2 / U22S2	Tamil – II / Hindi – II / Sanskrit – II	6	3	25	75	100
	II	U22E2	English – II	6	3	25	75	100
	III	U22ST3	Probability Theory	5	5	25	75	100
		U22ST2P	Practical – I(Non-Sitting)	3	3	25	75	100
		U22AMS2P	Mathematics – II(Non-Sitting)	3	3	25	75	100
		U22AMST3	Mathematics – III	5	5	25	75	100
	IV	U22STSBE1	Digital Era	2	2	25	75	100
			<b>30</b>	<b>24</b>				
III	I	U22T23/ U22H3 / U22S3	Tamil – III / Hindi – III / Sanskrit – III	6	3	25	75	100
	II	U22E3	English – III	6	3	25	75	100
	III	U22ST4	Discrete Probability Distributions	5	5	25	75	100
		U22ST5E1	Vital Statistics	3	3	25	75	100
		U22AMST4	Operations Research – I	4	4	25	75	100
		U22AMST5P	Operations Research – II (Non-Sitting)	2	-			
	IV	U22STSBE2	Introduction to R	2	2	25	75	100
U22STSBE3P		Computational Lab – I (Using R)	2	2	25	75	100	
			<b>30</b>	<b>22</b>				
IV	I	U22T4 / U22H4 / U22S4	Tamil – IV / Hindi – IV / Sanskrit – IV	6	3	25	75	100
	II	U22E4	English – IV	6	3	25	75	100
	III	U22ST6	Continuous Probability Distributions	5	5	25	75	100
		U22ST7P	Computational Lab – II (Using Spreadsheet)	3	3	25	75	100
		U22AMST5P	Operations Research – II (Non-Sitting)	2	3	25	75	100
		U22AMST6	Operations Research – III	4	4	25	75	100
	IV	U22STNME1P	Data Analysis using Excel	2	2	25	75	100
U22VE		Value Education	2	2	25	75	100	
			<b>30</b>	<b>25</b>				
V	III	U22ST8	Statistical Inference – I	6	5	25	75	100
		U22ST9	Applied Statistics	6	4	25	75	100
		U22ST10	C – Programming	5	4	25	75	100
		U22ST11P	Computational Lab – III (Using C)	3	3	25	75	100
		U22ST12E3	Sampling Techniques	6	5	25	75	100
	IV	U22STNME2P	Data Analysis using SPSS	2	2	25	75	100
		U22SS	Soft Skills	2	2	25	75	100
			<b>30</b>	<b>25</b>				
VI	III	U22ST13	Statistical Inference – II	5	5	25	75	100
		U22ST14	Design of Experiments	5	4	25	75	100
		U22ST15	Statistical Quality Control	6	4	25	75	100
		U22ST16P	Computational Lab – IV (Using SPSS)	3	3	25	75	100
		U22ST17E5	Actuarial Statistics	5	5	25	75	100
		U22ST18P	Group Project	5	4	50	50	100
	IV	U22GS	Gender Studies	1	1	25	75	100
			<b>30</b>	<b>26</b>				
<b>Total</b>				<b>180</b>	<b>140</b>			

**SEMESTER - I**

## CORE – I: DESCRIPTIVE STATISTICS

Semester: I  
Sub. Code: U22ST1

Hours: 5  
Credits: 5

### PREAMBLE

This is an introductory course in statistics designed to provide students with the basic concepts of statistics. Descriptive statistics are used to describe the basic concept and analyze of a univariate and bivariate data in a study.

### COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO No.	Course Outcome	Knowledge Level
CO1	<b>Recall</b> the basic concept data, survey, sampling, graphs, measures of central tendency, dispersion, correlation and regression	<b>K1</b>
CO2	<b>Classify</b> the data, diagrammatic, average, skewness, kurtosis and the concepts correlation and regression	<b>K2</b>
CO3	<b>Apply</b> the nature of graphs, discrete and continuous case of central tendency, dispersion and correlation	<b>K3</b>
CO4	<b>Analyze</b> the coefficient of variation and correlation coefficient between two variables, and inference of regression lines	<b>K4</b>
CO5	<b>Interpret</b> the relationship of averages, coefficient of variation, Karl Pearson's correlation and Spearman rank correlation	<b>K5</b>
CO6	<b>Construct</b> the graphs and simple linear regression equation	<b>K6</b>

### CO – PO MAPPING (Course Articulation Matrix)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	3	3	9	9
CO2	9	9	3	3	3	3
CO3	3	3	3	1	1	3
CO4	3	3	3	1	3	1
CO5	3	1	3	1	1	1
CO6	3	3	1	3	1	1
<b>Weightage</b>	<b>30</b>	<b>28</b>	<b>16</b>	<b>12</b>	<b>18</b>	<b>18</b>
<b>Weighted Percentage of Course contribution to PO's</b>	<b>55.56</b>	<b>51.85</b>	<b>29.63</b>	<b>22.22</b>	<b>33.33</b>	<b>33.33</b>

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

### **Unit I**

Statistics – Definition, Functions, Applications and Limitations – Statistical Survey: Planning and Executing – Data – Primary and Secondary – Drafting the Questionnaire – Pilot Survey

### **Unit II**

Sampling – Essentials and Methods of Sampling (Concept only) – Classification – Meaning and Objectives – Types – Formation of Distribution: Discrete, Continuous and Relative. Tabulation – Role, Parts and Rules – Diagrammatic and Graphs

### **Unit III**

Measures of Central Tendency: Average – Definition – Types – Arithmetic Mean (A.M.) – Merits and Demerits – Simple and Weighted – Median – Merits and Demerits - Mode – Relationship of Averages – Geometric Mean (G.M.) – Harmonic Mean (H.M.) – Relationship of A.M., G.M. and H.M – Simple Problem Only

### **Unit IV**

Measures of Dispersion: Variation – Definition – Properties – Methods of Studying Variation – Range – Quartile Deviation – Mean Deviation – Standard Deviation – Variance - Coefficient of Variation – Skewness – Kurtosis – Simple Problem Only

### **Unit V**

Correlation Coefficients – Definition - Karl Pearson’s – Spearman’s Rank Correlation – Regression Analysis Definition – Properties – Simple Linear Regression – Simple Problem Only

### **Text Books:**

1. S. P. Gupta (Reprint 2022): Statistical Methods, 46<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

Unit – I : Page No.: 1.7 – 1.16, 2.2 – 2.10, 3.2 – 3.12

Unit – II : Page No.: 4.2 – 4.5, 5.2 – 5.8, 5.15 – 5.19, 6.2 – 6.12, 6.24 – 6.28, 6.36 – 6.38

Unit – III : Page No.: 7.4 – 7.10, 7.14 – 7.22, 7.29 – 7.35, 7.38 – 7.41, 7.47 – 7.50 & 7.52

Unit – IV : Page No.: 8.2 – 8.20, 8.25 – 8.28, 9.2 – 9.22

Unit – V : Page No.: 10.2 – 10.15, 10.25 – 10.31, 11.2 – 11.14

2. B. L. Agarwal (Reprint, 2018): Programmed Statistics, 3<sup>rd</sup> Ed., New Age International Publishers.

Page No.: 07 – 10, 17, 30 – 34, 47 – 58, 72 – 80, 372 - 387

**\* Students should be trained to Descriptive and Solved Problems Questions based on Text Book – 1**

**\* Students should be trained to Objective Type Questions based on Text Book – 2**

### **Reference Book:**

S. C. Gupta and V. K. Kapoor (2020): Fundamental of Mathematical Statistics, 12<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

## CORE-II: PRACTICAL - I

Semester: I & II  
Sub. Code: U22ST2P

Hours: 6 (3 + 3)  
Credits: 3

### PREAMBLE

The main emphasis of this course is to equip the student with necessary analytic and technical skills to compute the various descriptive measures and probability theory concept by using calculator.

### COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO No.	Course Outcome	Knowledge Level
CO1	List the basic notations and formulas of descriptive statistics and probability theory	K1
CO2	Demonstrate the concept of statistical data using frequency table, graphical representations, descriptive statistics and Bayes theorem	K2
CO3	Solve the univariate and bivariate data of descriptive statistics, discrete and continuous random variables	K3
CO4	Examine the skewness, kurtosis, and random variables in probability theory	K4
CO5	Evaluate the concept of correlation coefficient, regression equations and Bayes theorem	K5
CO6	Solve the problems of conditional probability situation	K6

### CO – PO MAPPING (Course Articulation Matrix)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	3	3	1	9
CO2	9	3	3	3	3	9
CO3	3	3	1	3	1	3
CO4	3	1	1	1	3	3
CO5	3	1	3	1	1	3
CO6	1	1	3	3	3	1
Weightage	28	18	14	14	12	28
Weighted Percentage of Course contribution to PO's	51.85	33.33	25.93	25.93	22.22	51.85

Correlation between CO & PO 1: Low

3: Medium

9: High



## CONTENT

1. Construction of Frequency Table
2. Diagrammatic and Graphical Representation
3. Measures of Central Tendency
4. Measures of Dispersion
5. Measures of Skewness and Kurtosis
6. Correlation Coefficients
7. Regression Equations
8. Conditional Probability
9. Baye's Theorem
10. Random Variables (One & Two Dimensional)

**\* Practical – I based on Core Paper I & III**

**ALLIED-I: MATHEMATICS – I**

**Semester: I**  
**Sub. Code: U22AMST1**

**Hours: 5**  
**Credits: 5**

**PREAMBLE**

The learning objective of the algebra, matrices, differentiation and simple mathematical series is to provide students with important concept of fundamentals.

**COURSE OUTCOMES**

Upon completion of the course, the students will be able to

<b>CO No.</b>	<b>Course Outcome</b>	<b>Knowledge Level</b>
<b>CO1</b>	<b>Relate</b> the basic functions of binomial series, polynomial equations and Eigen values	<b>K1</b>
<b>CO2</b>	<b>Illustrate</b> the concept of exponential series, Horner ‘s method and logarithmic differentiation	<b>K2</b>
<b>CO3</b>	<b>Utilize</b> the Hamilton theorem, product rule and Jacobians of mathematical series	<b>K3</b>
<b>CO4</b>	<b>Distinguish</b> the irrational and complex roots, Taylor’s and Maclaurin’s series	<b>K4</b>
<b>CO5</b>	<b>Justify</b> the concept of partial fractions, matrix and inverse matrix	<b>K5</b>
<b>CO6</b>	<b>Discuss</b> exponential and logarithmic series, differentiation of $x^n$ , $e^x$ , $\log x$ , $\sin x$ , $\cos x$ , $\tan x$	<b>K6</b>

**CO – PO MAPPING (Course Articulation Matrix)**

<b>CO / PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO1</b>	9	3	3	3	1	1
<b>CO2</b>	9	9	3	1	3	1
<b>CO3</b>	1	3	1	3	1	3
<b>CO4</b>	3	1	3	1	3	1
<b>CO5</b>	1	3	1	1	1	3
<b>CO6</b>	1	1	1	3	1	1
<b>Weightage</b>	<b>24</b>	<b>20</b>	<b>12</b>	<b>12</b>	<b>10</b>	<b>10</b>
<b>Weighted Percentage of Course contribution to PO’s</b>	<b>44.44</b>	<b>37.04</b>	<b>22.22</b>	<b>22.22</b>	<b>18.52</b>	<b>18.52</b>

**Correlation between CO & PO 1: Low                      3: Medium                      9: High**

## CONTENT

### **Unit-I: Algebra**

Partial fractions, binomial, exponential and logarithmic series (statement only) summation and approximation – Simple problems only

### **Unit-II: Theory of Equations**

Polynomial equations with real coefficients, irrational roots, complex roots, symmetric functions of roots, transformation of equation by increasing decreasing roots by a constant - reciprocal equations. Horner's method to find a root approximately – Simple problems only

### **Unit-III: Matrices**

Symmetric, skew – symmetric, orthogonal and unitary matrices – consistency of equations, Eigen values and Eigen – vectors, Cayley – Hamilton theorem (without proof) – verification computation of inverse matrix using Cayley– Hamilton theorem– Simple problems only

### **Unit –IV: Differentiation**

Function – Classification of functions – Limit of a function – simple examples – Continuous function – Differentiation of  $x^n$ ,  $e^x$ ,  $\log x$ ,  $\sin x$ ,  $\cos x$ ,  $\tan x$  – product rule – Quotient rule – Functions of function (Exclude Hyperbolic function) Logarithmic differentiation (Omit-Transformation, Implicit functions) Differentiation of one function with respect to another function – Simple problems only

### **Unit-V: Mathematical Series**

Expression of function – Taylor's and Maclaurin's series (statement only) Expansion of  $e^x$ ,  $\sin x$ ,  $\cos x$ ,  $\log(1+x)$ ,  $(1+x)^n$  Jacobians

**\* Students should be trained to solve example problems only.**

### **Text Books:**

1. P.R.Vittal, Allied Mathematics, Margham Publications

**Unit-I:** Page 1.1 to 4.21, Examples: 1 to 7 (Page 1.2 to 1.7), Examples: 1 to 6 (Page 2.4 to 2.3), Examples: 1 to 6 (Page 3.3 to 3.6), Examples: 1 to 5 (Page 4.2 to 4.3); **Unit-II:** Page 6.1 to 6.69, Examples: 1 to 5 (Page 6.4 to 6.7), Example: 1 to 2 (Page 6.21 to 6.22), Examples: 1 to 5 (Page 6.27 to 6.29), Examples: 1 to 4 (Page 6.22 to 6.25); **Unit-III:** Page 5.1 to 5.9, 5.18 to 5.23, 5.39 to 5.47, 5.50 to 5.51, Examples: 1 to 5 (Page 5.8 to 5.11), Examples: 1 to 5 (Page 5.20 to 5.23), Examples: 1 to 2 (Page 5.41 to 5.42).

2. S. Narayanan, T. K. Manicavachagom Pillay (2009): Calculus (Vol. – I), Viswanathan, S., Printers & Publishers Pvt Ltd

**Unit-IV:** Page 1 to 11, 24 to 27, 30 to 37, 49 to 52, 60 to 62, Examples: 1 to 4 (Page 5 to 6), Examples: 1 to 5 (Page 31), Examples: 1, 2 (Page 32), Examples: 1 to 3 (Page 33 to 34), Examples: 1 to 6 (Page 38 to 39), Examples: 1 to 3 (Page 51); **Unit-V:** Chapter-7, Page 164-166, Examples: 1 to 5 (Page 166 to 171)

### **Reference Book:**

1. R.Hanumantha Rao & T.K.Manickavasagom Pillay S.Narayanan (2015): Ancillary Mathematics (Vol. – I) S.Vishwanathan Printers & Publishers

**ALLIED-II: MATHEMATICS – II**

**Semester: I & II**

**Hours: 6 (3 + 3)**

**Sub. Code: U22AMST2P**

**Credits: 3**

**PREAMBLE**

The learning objective of the algebraic and transcendental equations with solved methods, finite differences, Lagrange’s interpolation and Newton’s difference formula.

**COURSE OUTCOMES**

Upon completion of the course, the students will be able to

<b>CO No.</b>	<b>Course Outcome</b>	<b>Knowledge Level</b>
<b>CO1</b>	<b>List</b> the basic concept of algebraic equations, transcendental equations and finite differences	<b>K1</b>
<b>CO2</b>	<b>Explain</b> the method of bisection. False position, backward and forward differences	<b>K2</b>
<b>CO3</b>	<b>Apply</b> the iteration method, Newton Raphson method and Lagrange’s interpolation formula	<b>K3</b>
<b>CO4</b>	<b>Examine</b> the solutions of transcendental equations and finite differences	<b>K4</b>
<b>CO5</b>	<b>Interpret</b> the concept of Lagrange’s interpolation and Newton difference formula	<b>K5</b>
<b>CO6</b>	<b>Adapt</b> to find root the solution of various equations and finite differences	<b>K6</b>

**CO – PO MAPPING (Course Articulation Matrix)**

<b>CO / PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO1</b>	9	3	1	3	3	3
<b>CO2</b>	9	3	3	1	3	1
<b>CO3</b>	1	3	1	3	1	1
<b>CO4</b>	9	1	3	1	3	3
<b>CO5</b>	9	3	1	3	1	3
<b>CO6</b>	1	3	1	3	3	1
<b>Weightage</b>	<b>38</b>	<b>16</b>	<b>10</b>	<b>14</b>	<b>14</b>	<b>12</b>
<b>Weighted Percentage of Course contribution to PO’s</b>	<b>70.37</b>	<b>29.63</b>	<b>18.52</b>	<b>25.93</b>	<b>25.93</b>	<b>22.22</b>

**Correlation between CO & PO 1: Low**

**3: Medium**

**9: High**

## CONTENT

### **Unit-I**

Different methods to find the solutions of algebraic and transcendental equations – Bisection method – Method of False Position

### **Unit-II**

Iteration method — Newton Raphson method –Generalized Newton's method

### **Unit-III**

Finite Differences – Forward differences – Backward differences – Central differences –symbolic relations and separation of symbols

### **Unit-IV**

Newton's forward and backward difference formula – Lagrange's interpolation formula

### **Unit - V**

Numerical Differentiation: Newton's forward and backward difference formula

### **Text Book:**

S. S. Sastry, (2010): Introductory Methods of Numerical Analysis, Prentice Hall of India Pvt. Ltd

### **Reference Book:**

A. Singaravelu (2016): Numerical Methods, Meenakshi Agency

# **SEMESTER - II**

## CORE – III: PROBABILITY THEORY

Semester: I  
Sub. Code: U22ST3

Hours: 5  
Credits: 5

### PREAMBLE

The learning objective of the Probability Theory and Random Variables is to provide students with essential tools in probability theory to understand the theory of univariate and bivariate probability distributions and including the concept of Bayes' theorem.

### COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO No.	Course Outcome	Knowledge Level
CO1	<b>Remember</b> the basic knowledge on fundamental probability concepts, random variable, distribution function and mathematical expectation.	<b>K1</b>
CO2	<b>Understand</b> the concept of addition and multiplication probability, conditional probability, probability mass function and probability density function.	<b>K2</b>
CO3	<b>Apply</b> the related concept of discrete and continuous random variables and their probability distributions including expectation and moments.	<b>K3</b>
CO4	<b>Analyze</b> the properties of probability mass function, probability density function and bivariate random variables.	<b>K4</b>
CO5	<b>Evaluate</b> the theory of probability, conditional probability and mathematical Expectation.	<b>K5</b>
CO6	<b>Build</b> the applications of Chebychev's Inequality	<b>K6</b>

### CO – PO MAPPING (Course Articulation Matrix)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	3	3	3	3
CO2	9	3	3	3	3	3
CO3	9	3	3	3	1	3
CO4	3	1	3	1	3	1
CO5	3	1	3	1	1	1
CO6	3	1	1	3	1	1
Weightage	36	18	16	14	12	12
Weighted Percentage of Course contribution to PO's	<b>66.67</b>	<b>33.3</b>	<b>29.63</b>	<b>25.93</b>	<b>22.2</b>	<b>22.2</b>

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

### **Unit – I**

Probability – Classical and Empirical – Terminology – Axiomatic Probability – Addition Theorem - Multiplication Theorem – Conditional Probability - Baye’s Theorem - Simple Problem Only

### **Unit – II**

Random Variables - Discrete Case – Probability Mass Function - Continuous Case - Probability Density Function – Distribution Function – Properties - Simple Problem Only

### **Unit – III**

Two Dimensional Random Variables – Joint and Marginal Probability Mass Function – Joint and Marginal Density Function – Simple Problem Only

### **Unit – IV**

Mathematical Expectation – Properties – Variance - Properties – Covariance - Simple Problem Only

### **Unit – V**

Moment Generating Function – Properties – Cumulants - Properties – Characteristic Function - Properties – Inversion Theorem (Statement Only) – Uniqueness Theorem (Statement Only) - Hally Bray Theorem (Statement Only) - Chebychev’s Inequality

### **Text Book:**

1. S. C. Gupta and V. K. Kapoor (2020): Fundamental of Mathematical Statistics, 12<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

Unit – I : Page No.: 3.3 – 3.12, 3.27 – 3.29, 3.31, 3.41 – 3.43, 3.52 – 3.54, 4.4 – 4.12

Unit – II : Page No.: 5.3 – 5.22

Unit – III : Page No.: 5.34 – 5.51

Unit – IV : Page No.: 6.3 – 6.20

Unit – V : Page No.: 7.3 – 7.18, 7.28 – 7.36

2. B. L. Agarwal (Reprint, 2018): Programmed Statistics, 3<sup>rd</sup> Ed., New Age International Publishers.  
Page No.: 90 – 100, 138 – 140, 174 – 182

**\* Students should be trained to Descriptive and Solved Problems Questions based on Text Book – 1**

**\* Students should be trained to Objective Type Questions based on Text Book – 2**

### **Reference Book:**

S. P. Gupta (Reprint 2022): Statistical Methods, 46<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.





## CONTENT

### **Unit–I: Integral Calculus**

Integration of irrational, trigonometric functions, Bernoulli's formula for integration by parts, reduction formulae, properties of definite integral and simple problems, Evaluation of double, triple integrals, simple applications to area, volume and centroid – Simple problems only.

### **Unit –II: Ordinary Differential Equations**

First order and higher differential equations - Second order differential equations with constant coefficients  $e^{ax}$ ,  $\sin^{ax}$ ,  $\cos ax$

### **Unit–III: Partial Differential Equations**

Formation, complete integrals and general integrals, four standard types, Lagrange's equations - Simple problems only

### **Unit–IV: Sets and Functions**

Bounded sets – functions – supremum and infimum – sequences – limit of a function – sum and product of converging sequence–sequence  $\{a^n\}$ –Infinite series–convergence – divergence – Geometric series – Properties

### **Unit–V: Sequence and Series**

Test of comparison, Integral test and Cauchy's test D'Alembert's ratio test – Alternating series – Leibnitz's test – series of positive and negative terms – Absolute and conditional convergence

**Note:** Students should be trained to solve simple problems only.

### **Textbooks:**

1. P. R. Vittal (2012): Allied Mathematics, 3<sup>rd</sup> ed., Margham Publications.
2. Bali N. P and Manish Goyal, (2011): A Text book of Engineering Mathematics, 8<sup>th</sup> Ed., Laxmi Publications Pvt. Ltd.

### **References:**

1. Ancillary Mathematics by S. Narayanan and others, S. Viswanathan Publishers, 2009
2. Allied Mathematics by P. R. Vittal (Margham Publications) Shantinayakan, Differential Calculus, S. Chand & Co., 1964

## SKILL BASED ELECTIVE - I: DIGITAL ERA

Semester: II  
Sub. Code: U22STSBE1

Hours: 2  
Credits: 2

### PREAMBLE

The learning objective of the computers, networks, office automation tools, google forms, university grants commission, e-learning and big data analytics is to provide students with important concept of fundamentals.

### COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO No.	Course Outcome	Knowledge Level
CO1	<b>Define</b> the basic ideas of computers, office automation tools and MOOC	<b>K1</b>
CO2	<b>Summarize</b> the concept of operating system, google forms, and e-Governance	<b>K2</b>
CO3	<b>Construct</b> the uses of internet, applications of charts for Excel and evaluation of statistical software's	<b>K3</b>
CO4	<b>Theme</b> of MOOC, swayam and digital library	<b>K4</b>
CO5	<b>Explain</b> the concept of Big data and social networks	<b>K5</b>
CO6	<b>Elaborate</b> the use of EPR and Cyber Security	<b>K6</b>

### CO – PO MAPPING (Course Articulation Matrix)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	3	3	1
CO2	9	3	3	3	3	9
CO3	9	3	3	3	3	9
CO4	9	3	3	3	3	1
CO5	1	1	1	1	1	1
CO6	1	1	1	1	1	1
<b>Weightage</b>	38	20	20	14	14	22
<b>Weighted Percentage of Course contribution to PO's</b>	<b>70.37</b>	<b>37.00</b>	<b>37.04</b>	<b>25.93</b>	<b>25.90</b>	<b>40.70</b>

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

### **UNIT - I**

Fundamentals of Computers – Hardware - Software – Operating System – Windows Operating System – Mobile Operating System - Android – Communication System – Types of Networks – Uses of Internet

### **UNIT - II**

Office Automation Tools: Microsoft Word – Page Layout – Font Dialog Box – Creating a Table – Microsoft Excel – Format Cells – Charts – Formulas – Microsoft PowerPoint – Creating a Presentation – Google Forms

### **UNIT - III**

Electronic Governance – E-Governance in India – Common Service Centre – E-Governance Plan – Digital India – Agencies – Electronic Payment and Receipt (EPR) – Digital Locker – e-District Services

### **UNIT - IV**

University Grants Commission – E-Learning – Objectives – Massive Open Online Course (MOOC) – Swayam – Digital Library – E-Journals and Books – Cyber Security

### **UNIT - V**

Big Data – Data Analytics – Information Technology (IT) Act – Social Networks – Merits and Demerits – Statistical Software's – Applications – SPSS – R - SAS

### **Study Materials:**

[https://www.msuniv.ac.in/images/academic/ug/Computer%20for%20Digital%20Era%20%20E\\_Material.pdf](https://www.msuniv.ac.in/images/academic/ug/Computer%20for%20Digital%20Era%20%20E_Material.pdf)

<https://www.uc.edu/webapps/af/hr/CUSTOMGUIDE/content/content/computerbasics.pdf>

**\* Students should be trained to Objective and Descriptive Type Questions based on Study Materials**

# **SEMESTER - III**

## CORE- IV: DISCRETE PROBABILITY DISTRIBUTIONS

Semester: III  
Sub. Code: U22ST4

Hours: 5  
Credits: 5

### PREAMBLE

The impart knowledge on discrete distributions and their applications in various fields. These distributions often involve statistical analyses of counts of an event occurs.

### COURSE OUTCOMES

CO. No	Course Outcomes	Knowledge Level
CO1	Define Bernoulli-Binomial-Poisson-Geometric-Multinomial distribution	K1
CO2	Compare the M.G.F and C.G.F of Binomial- Negative Binomial distribution, Geometric-Hyper Geometric distribution	K2
CO3	Make use of distributions in problem solving	K3
CO4	Examine Poisson Approximation to Binomial distribution	K4
CO5	Justify fitting a Binomial and Poisson distribution	K5
CO6	Estimate Power series distribution	K6

### CO-PO MAPPING (course articulation matrix):

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	3	3	3	3	1
CO4	3	9	3	1	1	3
CO5	9	1	1	3	3	3
CO6	3	1	3	3	3	1
Weightage	42	32	28	28	22	20
Weighted percentage of course contribution to PO's	77.77	59.25	51.85	51.85	40.74	37.03

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

### **Unit – I**

Bernoulli – Binomial distribution – Moments Generating Function – Cumulants – Fitting a Binomial distribution - Simple Problem Only

### **Unit – II**

Poisson distribution – Moments Generating Function – Cumulants – Poisson Approximation to Binomial –Fitting a Poisson distribution – Simple Problem Only

### **Unit – III**

Negative Binomial distribution – Moment Generating Function – Cumulants – Poisson distribution limiting case of negative binomial distribution

### **Unit – IV**

Geometric distribution –Lack of Memory – Moment Generating Function – Hyper-Geometric Distribution – Approximation to Binomial

### **Unit – V**

Multinomial distribution – Moments – Applications - Power Series distribution – Moments – M.G.F. of PSD

### **Text Books:**

1. S. C. Gupta and V. K. Kapoor (2020): Fundamental of Mathematical Statistics, 12<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

Unit – I : Page No.: 8.3 – 8.12, 8.16 – 8.18, 8.21 – 8.23

Unit – II : Page No.: 8.30 – 8.36, 8.38 – 8.40, 8.47 – 8.49

Unit – III : Page No.: 8.52 – 8.59

Unit – IV : Page No.: 8.60 – 8.66

Unit – V : Page No.:8.67 – 8.73

2. B. L. Agarwal (Reprint, 2018): Programmed Statistics, 3<sup>rd</sup> Ed., New Age International Publishers. Page No.: 140 – 160

**\* Students should be trained to Descriptive and Solved Problems Questions based on Text Book – 1**

**\* Students should be trained to Objective Type Questions based on Text Book – 2**

### **Reference Book:**

S. P. Gupta (Reprint 2022): Statistical Methods, 46<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

## MAJOR ELECTIVE-I: VITAL STATISTICS

Semester: III  
Sub. Code: U22ST5E1

Hours: 3  
Credits: 3

### PREAMBLE

Vital Statistics is defined as the branch of biometry which deals with the data on live births, deaths, migration, foetal deaths, marriages and divorces.

### COURSE OUTCOMES

CO. No	Course Outcomes	Knowledge Level
CO1	Recall the role of vital statistics, uses and types of rates	K1
CO2	Classify Fertility, Mortality, Migration	K2
CO3	Identify CDR , ASDR, CBR, ASFR, IMR	K3
CO4	Compare General Fertility Rate and Total Fertility Rate	K4
CO5	Rule on Construction of life table	K5
CO6	Evaluate the population growth, NRR and GRR	K6

### CO-PO MAPPING (course articulation matrix)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	9	9	9
CO2	9	9	9	3	9	9
CO3	9	9	3	3	3	3
CO4	9	3	1	9	1	3
CO5	3	3	3	3	3	1
CO6	3	3	3	1	1	1
Weightage	42	36	28	28	26	26
Weightage percentage of course contribution to PO's	77.77	66.66	51.85	51.85	48.14	48.14

Correlation between CO & PO 1: Low

3: Medium

9: High



## CONTENT

### **Unit - I**

Introduction to Vital Statistics – Uses - Methods – Measurement of Population - Rates and Ratios of Vital Statistics

### **Unit - II**

Mortality – Crude Death Rate (C.D.R.) - Specific Death Rates (S.D.R.) – Age- Specific Death Rates (Age-S.D.R.) - Infant Mortality Rate (I.M.R.) - Standardized Death Rates – Simple Problem Only

### **Unit - III**

Life Table - Stationary and Stable Population – Central Mortality Rate - Force of Mortality – Assumptions, Description and Construction of Life Tables – Uses of Life Tables – Simple Problem Only

### **Unit - IV**

Fertility - Crude Birth Rate (C.B.R.) - General Fertility Rate (G.F.R.) - Specific Fertility Rate (S.F.R.) – Age-Specific Fertility Rate - Total Fertility rate (T.F.R.) – Simple Problem Only

### **Unit - V**

Population Growth – Crude Rate of Natural Increase - Pearl's Vital Index - Gross Reproduction Rate (G.R.R.) - Net Reproduction Rate (N.R.R.) – Simple Problem Only

### **Text Books:**

1. S. C. Gupta and V. K. Kapoor (2021): Fundamentals of Applied Statistics, 4<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

Unit – I to Unit - V: Page No.: 9.2 – 9.58

2. B. L. Agarwal (Reprint, 2018): Programmed Statistics, 3<sup>rd</sup> Ed., New Age International Publishers. Page No.: 542 – 548

**\* Students should be trained to Descriptive and Solved Problems Questions based on Text Book – 1**

**\* Students should be trained to Objective Type Questions based on Text Book – 2**

### **Reference Book:**

S. P. Gupta (Reprint 2022): Statistical Methods, 46<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.



## **CONTENT**

### **Unit I**

Operations Research – origin and development of O.R – Nature and Features of O.R – Definition of O.R – Scientific method in O.R – Methodology of O.R – Applications of O.R – Linear programming problem (LPP)- Mathematical formulation of LPP – Graphical Solution

### **Unit II**

Simple method – Big m method- Two – phase method.

### **Unit III**

Duality in LPP – Formulation and dual problem – Dual problem when primal problem is the standard form – dual problem when primal problem is in the mixed Form – Dual simple method

### **Unit IV**

Transportation problem –Initial Basic Feasible solution –North – West corner method – Least method and Vogel's Approximation method and MODI method to solve a Transportation problem.

### **Unit V**

Assignment problem – Balanced and Unbalanced Assignment problem – Hungarian method to solve an Assignment problem

### **Text Book:**

Kanti Swarup, P. K. Gupta and Manmohan (2017): Operations Research, Sultan Chand & Sons-New Delhi

### **Reference Book:**

Taha H. A. (2019): Operations Research: An Introduction, 10<sup>th</sup> Ed., Pearson.

## ALLIED – V: OPERATIONS RESEARCH - II

**Semester: III & IV** (Non-Sitting)

**Hours: 4 (2 + 2)**

**Sub. Code: U22AMST5P**

**Credits: 3**

### PREAMBLE

To equip the students with optimization Techniques and solve them

### COURSE OUTCOMES

CO. No	Course_Outcomes	Knowledge Level
CO1	<b>Recall</b> Graphical method and feasible solutions	<b>K1</b>
CO2	<b>Demonstrate</b> Sequencing problem, Assignment problem	<b>K2</b>
CO3	<b>Experiment with</b> Networking scheduling by PERT and CPM	<b>K3</b>
CO4	<b>Simplify</b> Simplex method, Big M method	<b>K4</b>
CO5	<b>Prove</b> Two phase method and Dual simplex method	<b>K5</b>
CO6	<b>Combine</b> NWC, VAM, LCM and Modi method	<b>K6</b>

### CO-PO MAPPING (course articulation matrix)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	3
CO3	9	9	3	3	3	1
CO4	9	3	3	1	1	1
CO5	3	3	1	1	1	1
CO6	9	3	3	3	1	1
<b>Weightage</b>	<b>48</b>	<b>36</b>	<b>28</b>	<b>26</b>	<b>18</b>	<b>16</b>
<b>Weighted percentage of course contribution to PO's</b>	<b>88.88</b>	<b>66.66</b>	<b>51.85</b>	<b>48.14</b>	<b>33.33</b>	<b>29.62</b>

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

1. Graphical Method
  2. Simplex Method
  3. Big M Method
  4. Two-Phase Method
  5. Duality and Dual Simplex Method
  6. Transportation problems:
    - North west method
    - Least cost method
    - VAM
    - MODI method
  7. Assignment problems
  8. Sequencing problems
- Networking scheduling by PERT & CPM

## SKILL BASED ELECTIVE - II: INTRODUCTION TO R

Semester: III  
Sub. Code: U22STSBE2

Hours: 2  
Credits: 2

### PREAMBLE

The learning objective of the R packages, working of dataset, functions, graphs and measures of central tendency, association and correlations is to provide students with important concept of fundamentals.

### COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO No.	Course Outcome	Knowledge Level
CO1	<b>Relate</b> the introduction of R, packages, working with graphs	<b>K1</b>
CO2	<b>Outline</b> the concept of data sorting, merging and transpose	<b>K2</b>
CO3	<b>Develop</b> the syntax of graphs and analysis tools	<b>K3</b>
CO4	<b>Function</b> of descriptive statistics and measures of association	<b>K4</b>
CO5	<b>Interpret</b> the concept of functions, charts and frequency table	<b>K5</b>
CO6	<b>Construct</b> the descriptive statistics and correlation coefficient	<b>K6</b>

### CO – PO MAPPING (Course Articulation Matrix)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	3	3	9
CO2	9	9	3	3	3	9
CO3	9	3	3	3	3	3
CO4	9	3	3	3	3	1
CO5	1	3	1	1	1	1
CO6	1	1	1	1	1	1
Weightage	38	28	20	14	14	24
Weighted Percentage of Course contribution to PO's	<b>70.4</b>	<b>51.9</b>	<b>37</b>	<b>25.9</b>	<b>25.9</b>	<b>44.44</b>

Correlation between CO & PO 1: Low 3: Medium 9: High

## CONTENT

### **UNIT - I**

Introduction – Installing R – Working with R – Packages – Working with Large Datasets – Understanding Datasets – Data Structures - Data Input – Annotating Datasets

### **UNIT - II**

Working with Graphs – Graphical Parameters – Adding Text, Customized Axes and Legends – Combining Graphs – Creating New Variables – Recoding and Renaming Variables – Missing Values – Type Conversions – Sorting and Merging Datasets

### **UNIT - III**

Functions - Mathematical Functions - Statistical Functions – Probability Functions – Character Functions – Applying Functions to Matrices and Data Frames – Control Flow – Transpose

### **UNIT - IV**

Graphs – Bar Plots – Pie Charts – Histograms – Kernel Density Plots – Box Plots – Dot Plots – Simple Syntax

### **UNIT - V**

Statistics – Descriptive Statistics – Frequency and Contingency Tables – Measures of Association – Correlations – Simple Syntax

### **Text Book:**

Kabacoff L. R (Reprint, 2020): R in Action: Data Analysis and Graphics with R, 2<sup>nd</sup> Ed., Dreamtech Press, New Delhi.

Unit – I : Page No.: 03 – 44

Unit – II : Page No.: 47 – 87

Unit – III : Page No.: 90 – 113

Unit – IV : Page No.: 117 – 136

Unit – V : Page No.: 137 – 157

**\* Students should be trained to Objective and Descriptive Type Questions based on Text Book**

## SKILL BASED ELECTIVE - III: COMPUTATIONAL LAB – I (USING R)

Semester: III  
Sub. Code: U22STSBE3P

Hours: 2  
Credits: 2

### PREAMBLE

The learning objective of the computations of diagrammatic & graphical representations, frequency tabulation, measures of central tendency & dispersion and correlation coefficient is to provide students with important concept of fundamentals.

### COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO No.	Course Outcome	Knowledge Level
CO1	List the construction of diagrammatic representations	K1
CO2	Infer the concept of measures of central tendency & dispersion	K2
CO3	Apply the syntax of statistical analysis	K3
CO4	Analyze of graphical representations and simple analysis tools	K4
CO5	Explain the concept of frequency tabulation and correlations	K5
CO6	Create the descriptive statistics and correlation coefficient	K6

### CO – PO MAPPING (Course Articulation Matrix)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	3	9
CO3	9	9	3	3	3	3
CO4	9	3	3	3	3	3
CO5	9	3	1	1	1	1
CO6	3	1	1	1	1	1
Weightage	48	34	26	26	20	26
Weighted Percentage of Course contribution to PO's	88.90	63.00	48.15	48.15	37.00	48.15

Correlation between CO & PO 1: Low

3: Medium

9: High



## CONTENT

1. Diagrammatic & Graphical Representations
  - ❖ Bar Diagram
  - ❖ Line Diagram
  - ❖ Pie Diagram
  - ❖ Histogram
2. Frequency Tabulation
3. Measures of Central Tendency
4. Measures of Dispersion
5. Correlation Analysis

**SEMESTER - IV**

## CORE- VI: CONTINUOUS PROBABILITY DISTRIBUTIONS

Semester: IV  
Sub. Code: U22ST6

Hours: 5  
Credits: 5

### PREAMBLE

Continuous probability distribution used in large number of applications, widely used in large sample theory where normality is involved.

### COURSE OUTCOMES

CO. No	Course Outcomes	Knowledge Level
CO1	Define Normal, Log Normal, Beta and Uniform distributions	K1
CO2	Relate Normal distribution limiting case of Binomial distribution	K2
CO3	Make use of continuous distribution to solve the problem	K3
CO4	Discover MGF and CGF of Normal distribution	K4
CO5	Prove De-Moivre's, Lindenberg and Levy, Liapounoff's and Cramer's Theorems	K5
CO6	Develop Mean, Variance and Moments of Exponential distribution	K6

### CO-PO MAPPING (course articulation matrix)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	9	3	3
CO2	9	9	3	3	3	3
CO3	9	3	3	1	1	1
CO4	3	9	3	1	1	1
CO5	9	3	1	1	1	1
CO6	9	3	3	3	3	1
Weightage	48	36	22	18	12	10
Weightage of course contribution to PO's	88.88	66.66	40.74	33.33	22.22	18.54

Correlation between CO & PO 1: Low 3: Medium 9: High

## CONTENT

### **Unit – I**

Normal distribution – Definition – Normal distribution limiting case of Binomial distribution – Characteristics of Normal curve — Median – Mode - Moment Generating Function – Cumulants

### **Unit – II**

Importance of Normal distribution – Fitting a Normal distribution –Simple Problem Only – Log-Normal Distribution (Concept Only)

### **Unit – III**

Uniform Distribution – Moments - Simple Problem Only – Triangular Distribution (Concept Only) – Gamma Distribution – Cumulant Generating Functions – Limiting form of Gamma – Additive Property

### **Unit – IV**

Beta Distribution – First and Second kind – Mean and Variance – Exponential Distribution – Definition – Moment Generating Function

### **Unit – V**

Central Limit Theorem – Applications – De-Moivre’s Theorem – Lindeberg Theorem – Levy Theorem – Liapounoff’s Theorem – Cramer’s Theorem (without proof)

### **Text Books:**

1. S. C. Gupta and V. K. Kapoor (2020): Fundamental of Mathematical Statistics, 12<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

Unit – I : Page No.: 9.4 – 9.14

Unit – II : Page No.: 9.16 – 9.22 & 9.29

Unit – III : Page No.: 9.30 – 9.40

Unit – IV : Page No.: 9.42 – 9.47, 9.53 – 9.58

Unit – V : Page No.:9.79 – 9.84, 9.87 – 9.90

2. B. L. Agarwal (Reprint, 2018): Programmed Statistics, 3<sup>rd</sup> Ed., New Age International Publishers.  
Page No.: 140 – 160

**\* Students should be trained to Descriptive and Solved Problems Questions based on Text Book – 1**

**\* Students should be trained to Objective Type Questions based on Text Book – 2**

### **Reference Book:**

- S. P. Gupta (Reprint 2022): Statistical Methods, 46<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.



# CONTENT

## 1. Diagrammatic Representations

- ❖ Bar Diagram: Simple and Multiple
- ❖ Line Diagram: Simple and Multiple
- ❖ Pie Diagram

## 2. Graphical Representations

- ❖ Histogram
- ❖ Curve Fitting

## 3. Measures of Central Tendency

## 4. Measures of Dispersion

## 5. Correlation Analysis

## 6. Regression Analysis

**ALLIED – VI: OPERATIONS RESEARCH – III**

**Semester: III**  
**Sub. Code: U22AMST6**

**Hours: 4**  
**Credits: 4**

**PREAMBLE**

Operations Research used to finding optimum solutions from available source to solve a real life problems

**COURSE OUTCOMES**

<b>CO No</b>	<b>Course Outcomes</b>	<b>Knowledge Level</b>
<b>CO1</b>	<b>Define</b> sequencing, network, queuing and game theory	<b>K1</b>
<b>CO2</b>	<b>Relate</b> maximin and minimax principle	<b>K2</b>
<b>CO3</b>	<b>Identify</b> Games with and without saddle point, mixed strategy	<b>K3</b>
<b>CO4</b>	<b>Categorize</b> classification of queuing model – M/M/1 queuing systems with finite and infinite capacity	<b>K4</b>
<b>CO5</b>	<b>Compare</b> EOQ with and without shortages	<b>K5</b>
<b>CO6</b>	<b>Construct</b> a network diagram by CPM and PERT	<b>K6</b>

**CO-PO MAPPING (course articulation matrix)**

<b>CO/PO</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>
<b>CO1</b>	9	9	9	9	3	3
<b>CO2</b>	9	9	9	3	3	3
<b>CO3</b>	9	9	3	3	3	3
<b>CO4</b>	3	3	3	3	1	1
<b>CO5</b>	3	3	1	1	1	1
<b>CO6</b>	9	3	3	3	3	1
<b>Weightage</b>	<b>42</b>	<b>36</b>	<b>28</b>	<b>22</b>	<b>14</b>	<b>12</b>
<b>Weightage of course contribution to PO's</b>	<b>77.77</b>	<b>66.66</b>	<b>51.85</b>	<b>40.74</b>	<b>25.92</b>	<b>22.22</b>

**Correlation between CO & PO 1: Low                      3: Medium                      9: High**

## CONTENT

### **Unit - I**

Sequencing problem – meaning – problem of sequencing – processing  $n$  jobs through two machines –  $n$  jobs through  $K$ -machines – 2 jobs through  $K$ - machines

### **Unit - II**

Game Theory – Two Person Zero – sum games, the maximin – minimax principle – Games without saddle points – mixed strategies – Graphical Solution of  $2 \times n$  and  $m \times 2$  Games – Dominance property

### **Unit - III**

Networking Scheduling By PERT/CPM

### **Unit - IV**

Queuing Theory – Introduction – Elements of a Queuing system – characteristics of queuing systems – classification of queuing Model – M/M/1 queuing systems with finite and infinite capacity

### **Unit - V**

Inventory control – EOQ with Shortage and without shortages – multi-item Deterministic problem

### **Text Book:**

Kanti Swarup, P. K. Gupta and Manmohan (2017): Operations Research, Sultan Chand & Sons-New Delhi

### **Reference Books:**

Taha H. A. (2019): Operations Research: An Introduction, 10<sup>th</sup> Ed., Pearson Publication



## NON-MAJOR ELECTIVE - I: DATA ANALYSIS USING EXCEL

Semester: IV  
Sub. Code: U22STNME1P

Hours: 2  
Credits: 2

### PREAMBLE

The learning objective of the computations of measures of central tendency & dispersion, correlation analysis, regression analysis and t – test is to provide students with important concept of fundamentals.

### COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO No.	Course Outcome	Knowledge Level
CO1	Recall the construction of diagrammatic representations	K1
CO2	Explain the concept of measures of central tendency & dispersion	K2
CO3	Make use of the formula of statistical analysis	K3
CO4	Theme of graphical representations and simple analysis tools	K4
CO5	Inference the concept of correlation and regression	K5
CO6	Estimate the regression analysis and t - test	K6

### CO – PO MAPPING (Course Articulation Matrix)

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	9	9	9
CO2	9	9	9	9	9	3
CO3	9	3	3	3	3	3
CO4	9	3	3	3	3	3
CO5	3	3	3	1	1	1
CO6	3	1	1	1	1	1
Weightage	42	28	28	26	26	20
Weighted Percentage of Course contribution to PO's	77.78	51.90	51.85	48.15	48.15	37.00

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

1. Diagrammatic & Graphical Representations
  - \* Bar Diagram
  - \* Line Diagram
  - \* Pie Diagram
  - \* Histogram
2. Measures of Central Tendency
3. Measures of Dispersion
4. Correlation Analysis
5. Regression Analysis
6. t - Test

**SEMESTER - V**

## CORE VIII: STASTICAL INFERENCE –I

Semester: V  
Code: U22ST8

Hours: 6  
Credits: 5

### PREAMBLE

Statistical inference is the process of making conclusion by statistical techniques. This technique applied for various field like education, industries, marketing etc.

### COURSE OUTCOMES

CO. No	Course Outcomes	Knowledge Level
CO1	<b>Tell</b> the Estimate, Estimation, Estimators, Parameters, Statistic, Parameters Space	<b>K1</b>
CO2	<b>Understand</b> the Characteristics of Estimators, Minimum variance unbiased Estimators	<b>K2</b>
CO3	<b>Utilize</b> the Maximum Likelihood Estimators and its properties	<b>K3</b>
CO4	<b>Analyze</b> the Method of minimum variance – Method of moments – Method of least squares.	<b>K4</b>
CO5	<b>Prove</b> the Cramer- Rao- Inequality theorem and Rao-Blackwell theorem	<b>K5</b>
CO6	<b>Test for</b> Confidence interval and Confidence limits for large and small sample	<b>K6</b>

### CO-PO MAPPING (course articulation matrix)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	9	9	3
CO2	9	9	9	3	9	9
CO3	9	3	3	9	1	1
CO4	3	3	1	9	9	3
CO5	9	9	9	3	9	9
CO6	9	9	9	9	9	9
<b>Weightage</b>	<b>48</b>	<b>40</b>	<b>40</b>	<b>42</b>	<b>46</b>	<b>34</b>
<b>Weighted percentage of course contribution to PO's</b>	<b>88.88</b>	<b>74.07</b>	<b>74.07</b>	<b>77.77</b>	<b>85.18</b>	<b>62.96</b>

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

### **Unit-I**

Introduction – Characteristics of estimators – Invariance property of consistent estimators – Sufficient conditions for consistency – Efficient estimators – Simple problem only

### **Unit-II**

Minimum Variance Unbiased Estimators – Sufficiency – Factorization theorem (statement only) – Cramer-Rao inequality – Rao-Blackwell theorem – Simple problem only

### **Unit-III**

Methods of Estimation – method of maximum likelihood estimation – Properties of maximum likelihood estimators – Theorems (statement only) – Simple problem only

### **Unit-IV**

Method of minimum variance – Method of moments – Method of least squares – Simple problem only

### **Unit-V**

Confidence Interval – Confidence Limits – Simple problem only

### **Text Books:**

1. S. C. Gupta and V. K. Kapoor (2020): Fundamental of Mathematical Statistics, 12<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

Unit – I : Page No.: 17.3 – 17.10

Unit – II : Page No.: 17.10 – 17.30

Unit – III : Page No.: 17.31 – 17.42

Unit – IV : Page No.: 17.43 – 17.47

Unit – V : Page No.: 17.48 – 17.53

2. B. L. Agarwal (Reprint, 2018): Programmed Statistics, 3<sup>rd</sup> Ed., New Age International Publishers.  
Page No.: 236 – 247

**\* Students should be trained to Descriptive and Solved Problems Questions based on Text Book – 1**

**\* Students should be trained to Objective Type Questions based on Text Book – 2**

### **Reference Book:**

- S. P. Gupta (Reprint 2022): Statistical Methods, 46<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

## CORE IX: APPLIED STATISTICS

Semester: V  
Sub. Code: U22ST9

Hours: 6  
Credits: 4

### PREAMBLE

To get knowledge on index numbers, time series and their applications in various fields. This application should be apply for various fields for framing policies.

### COURSE OUTCOMES

CO. No	Course Outcomes	Knowledge Level
CO1	<b>Remembering</b> the index numbers, weighted index numbers, Simple Aggregative Method – Simple Average of Price Relatives Method	<b>K1</b>
CO2	<b>Understanding</b> the Laspeyres , Paasche's , Bowley ,Fisher's, Marshall – Kelly's index numbers.	<b>K2</b>
CO3	<b>Applying</b> the Unit test, Time reversal test, Factor reversal test, Circular test	<b>K3</b>
CO4	<b>Analyzing</b> the Measurement of trend, Graphic method ,Semi-average method, Moving average method, Method of least squares.	<b>K4</b>
CO5	<b>Evaluating the</b> Ratio to trend method – Ratio to moving average method –Link relative method	<b>K5</b>
CO6	<b>Creating</b> the different types of index numbers and different types of trend	<b>K6</b>

### CO-PO MAPPING (course articulation matrix)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	3	1	9
CO2	3	9	3	9	9	9
CO3	9	1	9	9	9	9
CO4	9	3	3	9	9	3
CO5	9	9	9	1	9	9
CO6	9	9	9	9	9	9
<b>Weightage</b>	<b>48</b>	<b>40</b>	<b>42</b>	<b>40</b>	<b>46</b>	<b>48</b>
<b>Weighted percentage of course contribution to PO's</b>	<b>88.88</b>	<b>74.07</b>	<b>77.77</b>	<b>74.07</b>	<b>85.18</b>	<b>88.88</b>

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

### **Unit – I**

Index Numbers- Definition- Uses - Classification – Methods of Constructing Index Numbers – Unweighted Index Numbers – Simple Aggregative Method – Simple Average of Price Relatives Method – Simple Problem Only

### **Unit – II**

Weighted Index Numbers – Laspeyres – Paasche’s – Bowley – Fisher’s – Marshall – Kelly’s – Simple Problem Only

### **Unit – III**

Tests of Adequacy – Unit test – Time reversal test (with proof) – Factor reversal test (with proof) – Circular test – Chain Index Numbers – Constructing a Chain Index – Conversion of Chain Index to Fixed Index – Simple Problem Only

### **Unit – IV**

Times series – Definition – Utility – Components – Measurement of trend – Graphic method – Semi-average method – Moving average method – Method of least squares (Fitting the straight line) – Simple Problem Only

### **Unit – V**

Measurement of seasonal variations – Method of simple averages – Ratio to trend method – Ratio to moving average method – Link relative method – Simple Problem Only

### **Text books:**

1. S. P. Gupta (Reprint 2022): Statistical Methods, 46<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

Unit – I : Page No.: 13.2 – 13.13    Unit – II : Page No.: 13.14 – 13.23

Unit – III : Page No.: 13.24 – 13.32    Unit – IV : Page No.: 14.2 – 14.29

Unit – V : Page No.: 14.38 – 14.50

2. B. L. Agarwal (Reprint, 2018): Programmed Statistics, 3<sup>rd</sup> Ed., New Age International Publishers.  
Page No.: 440 – 444, 467 – 471

**\* Students should be trained to Descriptive and Solved Problems Questions based on Text Book – 1**

**\* Students should be trained to Objective Type Questions based on Text Book – 2**

### **Reference Book:**

S. C. Gupta and V. K. Kapoor (2021): Fundamentals of Applied Statistics, 4<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

## CORE X: C – PROGRAMMING

Semester: V  
Sub. Code: U22ST10

Hours: 5  
Credits: 4

### PREAMBLE

To get knowledge on c-programming, character set, tokens, structures and arrays. To understand and coding the syntax in C.

### COURSE OUTCOMES

CO. No	Course Outcomes	Knowledge Level
CO1	<b>Define</b> the Character set, Tokens, Key words, Identifiers, constants, variables and data types	<b>K1</b>
CO2	<b>Illustrate</b> the operators, categories, expressions, input and output operations, reading a character.	<b>K2</b>
CO3	<b>Build</b> the decision making, branching, simple IF statement, IF-ELSE statement, nesting of IF-ELSE statement.	<b>K3</b>
CO4	<b>Examine</b> the decision making, looping structure of loop control, WHILE Statement Do Statement FOR Statement.	<b>K4</b>
CO5	<b>Asses</b> array, one-dimensional arrays, declaration and initialization of one-dimensional arrays and two-dimensional arrays.	<b>K5</b>
CO6	<b>Develop</b> user–defined functions, elements, definition of functions, structures and unions	<b>K6</b>

### CO-PO MAPPING (course articulation matrix):

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	3	1	9
CO2	3	9	3	9	9	9
CO3	9	1	9	9	9	9
CO4	3	3	3	9	9	3
CO5	9	9	9	1	9	9
CO6	9	9	9	9	9	9
<b>Weightage</b>	<b>42</b>	<b>40</b>	<b>42</b>	<b>40</b>	<b>46</b>	<b>48</b>
<b>Weighted percentage of course contribution to PO's</b>	<b>77.77</b>	<b>74.07</b>	<b>77.77</b>	<b>74.07</b>	<b>85.18</b>	<b>88.88</b>

Correlation between CO & PO 1: Low

3: Medium

9: High



## CONTENT

### **Unit – I**

Introduction to C – Basic structure of C Programs – Character set – C Tokens – Key words and Identifiers – Constants – Variables - Data types - Declarations of Variables

### **Unit – II**

Operators - categories – Expressions – Input and Output Operations – reading a character – writing a character – formatted input – formatted output

### **Unit – III**

Decision Making and Branching - Simple IF Statement – IF-ELSE Statement –Nesting of IF-ELSE Statement – ELSE-IF Ladder - Switch Statement – ? : Operator – GOTO Statement

### **Unit – IV**

Decision Making and Looping – Structure of Loop Control – Sentinel Loops – WHILE Statement - Do Statement – FOR Statement

### **Unit – V**

Array – One-dimensional arrays – Declaration and Initialization of One-dimensional arrays – Two-dimensional arrays – Declaration and Initialization of Two-dimensional arrays – User-defined functions –elements – definition of functions – Structures and Unions

**\* Kindly avoid program based questions because they are done in core practical**

### **Text Book:**

E. Balagurusamy (Reprint, 2019): Programming in ANSI C, 8<sup>th</sup> Ed., McGraw Hill Education (India) Pvt. Ltd.

Unit – I : Page No.: 17 – 22 & 28, 39 – 50

Unit – II : Page No.: 68 – 82, 100 – 119

Unit – III : Page No.: 131 – 154

Unit – IV : Page No.: 171 – 182

Unit – V : Page No.: 212 – 229, 291 – 297, 347 – 349, 365 – 368

**\* Students should be trained to Objective and Descriptive Type Questions based on Text Book**

### **Reference:**

[https://www.unf.edu/~wkloster/2220/ppts/cprogramming\\_tutorial.pdf](https://www.unf.edu/~wkloster/2220/ppts/cprogramming_tutorial.pdf)



## CONTENT

1. Create a Bio – Data using SCANF and PRINTF functions
2. Compute simple and compound interest
3. Whether a given number is odd or even
4. Compute the Gross Salary for Employer
5. Sort an Array
6. Compute an Average using array
7. Writing a character string / number in reverse order
8. Find the factorial of a Number
9. Whether a given number is Palindrome or not
10. Compute Mean and Variance
11. Compute Correlation Coefficients
12. Compute Regression coefficients

## MAJOR ELECTIVE-III: SAMPLING TECHNIQUES

Semester: V  
Sub. Code: U22ST12E3

Hours: 6  
Credits: 5

### PREAMBLE

To get erudition of random selection, allowing students to make strong statistical inference about the whole group. To get erudition the sampling theory and it's applied in various departments.

### COURSE OUTCOMES

CO. No	Course Outcomes	Knowledge Level
CO1	Name the population, sample, sample size, standard error, sampling, non-sampling error.	K1
CO2	Illustrate the simple random sampling, stratified random sampling and systematic random sampling.	K2
CO3	Identify the estimation of population parameter and proportion, estimation of sample size, principles of sample survey.	K3
CO4	Categorize the allocation, optimum allocation, proportional allocation, Neyman-allocation.	K4
CO5	Detetmine the ratio estimation means per unit, comparison with the mean per unit and ratio estimator.	K5
CO6	Tests the ratio estimation, regression estimation and difference estimation.	K6

### CO-PO MAPPING (course articulation matrix)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	3	9	9
CO2	9	9	1	9	9	9
CO3	3	9	9	9	9	9
CO4	1	9	9	9	9	3
CO5	9	3	9	9	1	3
CO6	9	3	9	9	1	3
Weightage	40	42	46	48	38	36
Weighted percentage of course contribution to PO's	74.07	77.77	85.18	88.88	70.37	66.66

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

### **Unit - I**

Population – Sample – Sample Size – Sampling Distribution – Standard Error – Standard Error of Statistic – Principles of Sample Survey – Sampling and Non-Sampling Errors – Census – Limitations of Sampling – Types of Sampling

### **Unit - II**

Simple Random Sampling - Procedures of selecting a random sample – Merits and Demerits – Attributes - Simple Problem Only – Estimation of Population Parameters and Proportion – Estimation of Sample Size

### **Unit - III**

Stratified Random Sampling - Advantages – Estimation of Variance - Allocation of Sample Size – Proportional Allocation – Optimum Allocation – Equal Allocation – Neyman's Allocation - Optimum Allocation and Proportional Allocation - Relative Precision of Stratified Random Sampling with Simple Random Sampling

### **Unit - IV**

Systematic Random Sampling – Some important theorems – Merits and Demerits – Circular Systematic sampling – Comparison of Simple Random Sampling and Stratified Random Sampling with Systematic Sampling – Cluster and Quota Sampling

### **Unit - V**

Ratio Estimation – Definition - Bias of ratio estimation - comparison of the ratio estimation with the mean per unit-Regression estimation – Difference Estimators - Comparison with the Mean per unit and Ratio estimators

### **Text Books:**

1. D. Singh and F. S. Chaudhary (2018): Theory and Analysis of Sample Survey Design, 1<sup>st</sup> Ed, New Age International Publishers.

Unit – I : Page No.: 1 – 18

Unit – II : Page No.: 19 – 47 Unit – III : Page No.: 48 – 58

Unit – IV : Page No.: 81 – 109

Unit – V : Page No.: 147 – 178

2. B. L. Agarwal (Reprint, 2018): Programmed Statistics, 3<sup>rd</sup> Ed., New Age International Publishers.  
Page No.: 202 – 212

**\* Students should be trained to Descriptive Type Questions based on Text Book – 1**

**\* Students should be trained to Objective Type Questions based on Text Book – 2**

### **Reference Book:**

S. C. Gupta and V. K. Kapoor (2021): Fundamentals of Applied Statistics, 4<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.



## CONTENT

1. Diagrammatic & Graphical Representations
  - \* Bar Diagram
  - \* Line Diagram
  - \* Pie Diagram
  - \* Histogram
2. Measures of Central Tendency
3. Measures of Dispersion
4. Frequency Tabulation
5. Correlation Analysis
6. Chi-square Test

**SEMESTER - VI**





## CONTENT

### **Unit - I**

Testing of Hypothesis – Null and Alternative Hypothesis – Types of Errors – Level of Significance – Procedure for solving testing of hypothesis – Most powerful test – Uniformly most powerful test – Neyman–Pearson lemma – Simple problem only

### **Unit - II**

Likelihood Ratio test (L.R.T.) – Parameter Space – Properties of L.R.T. – Test for the Mean of a Normal Population – Test for the Variance of a Normal Population

### **Unit - III**

Large Sample: Test of significance for single Mean – Test of significance for difference Means – Test of significance for single and difference of Standard deviations – Simple problem only

### **Unit - IV**

Small Sample: t-Test for Single and Difference Means – F-test for equality of Two Population Variances – Test for Goodness of Fit and Independence of Attributes – Simple problem only

### **Unit - V**

Non-parametric Methods – Advantages – Run Test – Test for Randomness – Median Test – Sign Test – Mann-Whitney U test - Simple problem only

### **Textbook**

1. S. C. Gupta and V. K. Kapoor (2020): Fundamental of Mathematical Statistics, 12<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

Unit – I : Page No.: 18.3 – 18.15

Unit – II : Page No.: 18.21 – 18.38

Unit – III : Page No.: 14.21 – 14.34

Unit – IV : Page No.: 16.13 – 16.23, 16.37 – 16.40 & 15.24 – 15.38

Unit – V : Page No.: 18.39 – 18.50

2. B. L. Agarwal (Reprint, 2018): Programmed Statistics, 3<sup>rd</sup> Ed., New Age International Publishers. Page No.: 277 – 289, 323 – 335

**\* Students should be trained to Descriptive and Solved Problems Questions based on Text Book – 1**

**\* Students should be trained to Objective Type Questions based on Text Book – 2**

### **Reference Book:**

S. P. Gupta (Reprint 2022): Statistical Methods, 46<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

## CORE XIV: DESIGN OF EXPERIMENTS

Semester: VI  
Sub. Code: U22ST14

Hours: 5  
Credits: 4

### PREAMBLE

To learning knowledge of the experimental design in agricultural field and to understand of the factorial experiments apply for laboratories, research and natural sciences.

### COURSE OUTCOMES

CO. No	Course Outcomes	Knowledge Level
CO1	<b>Recall</b> the design of experiments, analysis of variance and its classifications.	<b>K1</b>
CO2	<b>Relate</b> the completely randomized design, Randomized Block Design, Latin Square Design, Estimation of One Missing Values in R.B.D.	<b>K2</b>
CO3	<b>Experiment</b> of $2^2$ factorial design, Yates Method, $2^3$ factorial design.	<b>K3</b>
CO4	<b>Distinguish</b> the confounding in factorial design, confounding in $2^3$ experiment partial confounding in $2^3$ experiments, split plot design.	<b>K4</b>
CO5	<b>Choose</b> the C.R.D, R,B.D, L.S.D, B.I.B.D	<b>K5</b>
CO6	<b>Design</b> the experiments and apply the any one of the randomized designs in which the degree of uncertainty with which the inference is drawn.	<b>K6</b>

### CO-PO MAPPING (course articulation matrix):

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	3	9	9
CO2	9	9	1	9	9	9
CO3	9	9	9	9	9	3
CO4	9	9	3	9	9	1
CO5	3	3	9	3	1	9
CO6	9	3	9	3	1	9
<b>Weightage</b>	<b>48</b>	<b>42</b>	<b>40</b>	<b>36</b>	<b>38</b>	<b>40</b>
<b>Weighted percentage of course contribution to PO's</b>	<b>88.88</b>	<b>77.77</b>	<b>74.07</b>	<b>66.66</b>	<b>70.37</b>	<b>74.07</b>

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

### UNIT - I

Design of Experiments – Introduction – Terminology in Experimental Design – Principles of Experimental Design – Analysis of variance – Assumptions – One-way classification – Two-way classification – Simple problem only

### UNIT - II

Completely Randomized Design (C.R.D.) – Advantages and Disadvantages – Statistical Analysis of C.R.D. – Randomized Block Design (R.B.D.) – Advantages and Disadvantages – Statistical Analysis of R.B.D. (one observation) – Latin Square Design (L.S.D.) – Statistical Analysis of L.S.D. (one observation) – Estimation of One Missing Values in R.B.D.

### UNIT - III

Factorial Experiments – Advantages –  $2^2$  Factorial Design – Main and Interaction Effects of  $2^2$  Design – Statistical Analysis of  $2^2$  Design – Yates Method –  $2^3$  Factorial Design – Statistical Analysis of  $2^3$  Design

### UNIT - IV

Confounding in Factorial Design – Definition – Confounding in  $2^3$  Experiment – Partial Confounding in  $2^3$  Experiment – Split Plot Design

### UNIT - V

Balanced Incomplete Block Design (B.I.B.D.) – Definition – Parameters – Incidence Matrix – Symmetric B.I.B.D. – Resolvable Design – Intra Block Analysis of B.I.B.D.

#### Text books:

1. S. C. Gupta and V. K. Kapoor (2021): Fundamentals of Applied Statistics, 4<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi.

Unit – I : Page No.: 6.2 – 6.9, 5.2 – 5.9, 5.18 – 5.29 & 5.37 – 5.41

Unit – II : Page No.: 6.10 – 6.12, 6.17 – 6.20 & 6.30 – 6.34

Unit – III : Page No.: 6.83 – 6.95

Unit – IV : Page No.: 6.100 – 6.104, 6.117 – 6.118 & 6.126 – 6.127

Unit – V : Page No.: 6.128 – 6.135

2. B. L. Agarwal (Reprint, 2018): Programmed Statistics, 3<sup>rd</sup> Ed., New Age International Publishers.

Page No.: 612 – 627

**\* Students should be trained to Descriptive and Solved Problems Questions based on Text Book – 1**

**\* Students should be trained to Objective Type Questions based on Text Book – 2**

#### Reference book:

D. C. Montgomery (2013): Design and Analysis of Experiments, 8<sup>th</sup> Ed. John Wiley & Sons, Inc.

## CORE XV: STATISTICAL QUALITY CONTROL

Semester: VI  
Sub. Code: U22ST15

Hours: 6  
Credits: 4

### PREAMBLE

The learning knowledge of statistical quality control and the different kinds of charts are used. The create a chart using the quality all along the arrival of materials through each of their processing to the final delivery of goods.

### COURSE OUTCOMES

CO. No	Course Outcomes	Knowledge Level
CO1	<b>Define</b> the statistical quality control, definition, process and product control, control charts, tools for S.Q.C,	<b>K1</b>
CO2	<b>Explain</b> the control charts for variables, average ( $\bar{X}$ ) chart, range (R) chart, standard deviation ( $\sigma$ ) chart.	<b>K2</b>
CO3	<b>Build</b> the control charts for attributes, chart for fraction defective, chart for number of defectives, chart for number of defects per unit.	<b>K3</b>
CO4	<b>Classify</b> the operating characteristic curve, averages sample number, average amount of total inspection, acceptance sampling inspection plans.	<b>K4</b>
CO5	<b>Compare</b> the sequential sampling plan, sequential probability ratio test, oc curve and average sample number.	<b>K5</b>
CO6	<b>Creation</b> and development of a product quality evaluation through improved inspection procedure.	<b>K6</b>

### CO-PO MAPPING (course articulation matrix):

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	3	9	9
CO2	9	9	3	9	9	9
CO3	9	9	9	9	9	3
CO4	9	9	3	9	9	1
CO5	3	3	9	9	1	3
CO6	9	9	9	1	1	9
<b>Weightage</b>	<b>48</b>	<b>48</b>	<b>42</b>	<b>40</b>	<b>38</b>	<b>34</b>
<b>Weighted percentage of course contribution to PO's</b>	<b>88.88</b>	<b>88.88</b>	<b>77.77</b>	<b>74.07</b>	<b>70.37</b>	<b>62.96</b>

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

### **UNIT - I**

Statistical Quality Control (S.Q.C.) – Basis – Definition – Benefits – Process and Product Control – Control Charts – Tools for S.Q.C

### **UNIT - II**

Control Charts for Variables – Average ( $\bar{X}$ ) Chart – Range (R) Chart – Standard Deviation ( $\sigma$ ) Chart – Simple Problem Only

### **UNIT - III**

Control Charts for Attributes – Chart for Fraction Defective (p – chart) – Chart for Number of Defectives (d – chart) – Chart for Number of Defects per Unit (c – chart) – Simple Problem Only

### **UNIT - IV**

Operating Characteristic (OC) Curve – Average Sample Number (ASN) – Average amount of Total Inspection (ATI) – Acceptance Sampling Inspection Plans – Single Sampling Plan – determination of n and c, AOQL, OC Curve - Double Sampling Plan

### **UNIT - V**

Sequential Sampling Plan - Sequential Probability Ratio Test (S.P.R.T.) – OC and ASN Function of Sequential Sampling Plan

### **Text Books:**

S. C. Gupta and V. K. Kapoor (2021): Fundamentals of Applied Statistics, 4<sup>th</sup> Rev. Ed., Sultan Chand & Sons, New Delhi. Unit – I to V: Page No.: 1.2 – 1.69

**\* Students should be trained to Objective, Descriptive and Solved Problems Questions based on Text Book**

### **Reference Book:**

Montgomery D. C. (2013): Introduction to Statistical Quality Control, 7<sup>th</sup> Ed. John Wiley & Sons, Inc.

## CORE- XVI: COMPUTATIONAL LAB – IV (Using SPSS)

Semester: VI  
Sub. Code: U22ST16P

Hours: 3  
Credits: 3

### PREAMBLE

To learning the knowledge on writing a c-programming and create an own coding in C.

### COURSE OUTCOMES

CO. No	Course Outcomes	Knowledge Level
CO1	Relate the basic idea of graphical representations	K1
CO2	Illustarte the measures of central tendency & dispersion	K2
CO3	Construct the diagrammatic and parametric test analysis	K3
CO4	Function of the bivariate analysis	K4
CO5	Explain the non-parametric test analysis	K5
CO6	Predict the p-value of the given data set	K6

### CO-PO MAPPING (course articulation matrix):

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	1	3	1	9
CO2	9	9	9	9	9	9
CO3	9	1	9	9	9	9
CO4	3	3	9	9	9	3
CO5	9	9	9	1	9	9
CO6	9	9	9	9	9	9
Weightage	48	40	46	40	46	48
Weighted percentage of course contribution to PO's	88.88	74.07	85.18	74.07	85.18	88.88

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

### 1. Diagrammatic & Graphical Representations

- ❖ Bar Diagram: Simple and Multiple
- ❖ Line Diagram: Simple and Multiple
- ❖ Pie Diagram
- ❖ Histogram

### 2. Measures of Central Tendency

### 3. Measures of Dispersion

### 4. Correlation Analysis

### 5. Regression Analysis

### 6. Parametric Test

- ❖ One sample t-test
- ❖ Paired t-test
- ❖ Independent t-test
- ❖ One-way ANOVA test

### 7. Chi – square Test

### 8. Non – Parametric Test

- ❖ Wilcoxon Signed-Rank test
- ❖ Mann-Whitney U test



## MAJOR ELECTIVE – V: ACTUARIAL STATISTICS

Semester: VI  
Sub. Code: U22ST17E5

Hours: 5  
Credits: 5

### PREAMBLE

Actuarial science used to analyze the financial costs of risk and uncertainty. And in this paper, we include quantitative aptitude to develop the student's ability skills.

### COURSE OUTCOMES

CO. No	Course Outcomes	Knowledge level
CO1	<b>Define</b> Simple interest, Compound interest, Perpetuity, Annuity	<b>K1</b>
CO2	<b>Classify</b> Immediate Annuity, Deferred Annuity, Accumulated Annuity	<b>K2</b>
CO3	<b>Make use</b> of these concepts in real life. i.e Profit- Loss, Ratio- Proportion, Time-Distance, Time-work	<b>K3</b>
CO4	<b>Analyze</b> the effective rate of interest- Nominal rate of interest	<b>K4</b>
CO5	<b>Estimate</b> the accumulation and present values of perpetuity, Increasing and decreasing perpetuity	<b>K5</b>
CO6	<b>Solve</b> the Problems on ages, Problems on numbers and percentage.	<b>K6</b>

### CO-PO MAPPING (course articulation matrix)

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	9	9	9	9	9	9
CO2	9	9	9	3	3	1
CO3	9	9	9	9	9	9
CO4	3	3	3	3	1	1
CO5	3	9	3	1	1	1
CO6	9	9	9	3	3	3
<b>Weightage</b>	<b>42</b>	<b>48</b>	<b>42</b>	<b>28</b>	<b>26</b>	<b>24</b>
<b>Weighted percentage of course contribution of PO'S</b>	<b>77.77</b>	<b>88.88</b>	<b>77.77</b>	<b>51.85</b>	<b>48.14</b>	<b>44.44</b>

Correlation between CO & PO 1: Low

3: Medium

9: High

## CONTENT

### **Unit I**

Simple Interest – Compound Interest - Effective rate of interest - Nominal rate of interest - Varying rate of interest –effective rate corresponding to a nominal rate and vice-versa present value-accumulated value - discounts - Simple Problem Only

### **Unit II**

Annuities- immediate annuity – annuity - deferred annuity-accumulation and present values of annuities-increasing and decreasing annuities - Simple Problem Only

### **Unit III**

Perpetuity - Immediate perpetuity – perpetuity due-deferred perpetuity - accumulation and present values of perpetuity - Increasing and decreasing perpetuity - Simple Problem Only

### **Unit IV**

Problems on Numbers - Problems on Ages - Percentage

### **Unit V**

Profit and Loss – Ratio and Proportion – Time and Work - Time and Distance

### **Text Books:**

1. Mathematical basis of life assurance-IC-81, Insurance Institute of India  
Unit – I: Page No.: 01 - 16, Unit - II & III: Page no.: 27 to 67
2. R. S. Aggarwal (2017): Quantitative Aptitude for Competitive Examinations, Sultan Chand & Sons, New Delhi.  
Unit – IV: Page No.: 161 - 181, 182 - 194, 208 - 250, Unit – V: Page No.: 251 - 293, 294 - 310, 341 - 370, 384 - 404

### **References:**

1. <https://www.pnw.edu/wp-content/uploads/2020/03/attendance7-1.pdf>
2. <https://www.pearson.com/content/dam/one-dot-com/one-dot-com/us/en/higher-ed/en/products-services/course-products/lial-applied-mathematics-info/pdf/LGR-Finite-Ch5.pdf>

## CORE- XVIII: **PROJECT**

**Semester: VI**  
**Sub. Code: U22ST18P**

**Hours: 5**  
**Credits: 4**

### **GROUP PROJECT**

**Objective:** To enable the students to apply the statistical techniques for solving real-life problems.

A good project goes a long way in providing practical training to the students. They get an opportunity through the project to apply some of the vital theoretical concepts and techniques that had learnt in the previous Semesters.

On most of the occasions, socio-economic survey and market research surveys are periodically conducted by government agencies, NGO's and private organizations. So, it is proposed to offer good project topics to the students in these practical areas. The students will be thoroughly trained through the project not only in scientific selection of sample for data collection, but also in identifying and applying approximate statistical techniques in their projects.