MARUDHAR KESARI JAIN COLLEGE FOR WOMEN (AUTONOMOUS)

Vaniyambadi – 635 751

Department of Statistics

for

Undergraduate Programme

Bachelor of Science in Statistics

Regulations 2024-2025

CONTENT

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE

1. Preamble

The Department of Statistics was established in 2018.(Bachelor of Science (B.Sc)Course the Department of Statistics is an exciting space to engage with the quantitative aspects of the social, biological sciences. Focusing on the increasing role of Statistics in diverse areas and its indispensability in marketing, finance and strategy-making, students are trained to acquire tools in the areas of applied statistical methods analysis.

Demonstrate a solid understanding of foundational concepts in statistics, including probability theory, descriptive statistics, inferential statistics, and statistical methods. Apply a variety of statistical techniques and methods to analyze data sets, including hypothesis testing, regression analysis, time series analysis, and multivariate analysis. Acquire skills in data collection, data cleaning, data transformation, and data management techniques to prepare datasets for analysis. Demonstrate proficiency in using statistical software packages such as R, Python and SPSS for data analysis, visualization, and statistical modeling. Design and conduct experiments, surveys, and observational studies, including sample size determination, randomization, and control of experimental variables. Understand the principles of statistical inference, including estimation, hypothesis testing, confidence intervals, and p-values, and apply them to draw conclusions from data. Develop statistical models to describe and predict relationships between variables, including linear models, generalized linear models, and time series models. Apply statistical quality control techniques, such as control charts, process capability analysis, and Six Sigma methodologies, to improve processes and ensure product quality.

Conduct statistical research projects, including formulating research questions, designing studies, collecting and analyzing data, and interpreting and presenting results. Develop critical thinking skills to evaluate statistical methods, assumptions, and conclusions critically and apply appropriate statistical techniques to solve real-world problems. Communicate statistical concepts, methods, and findings effectively through written reports, presentations, and visualizations to diverse audiences. Understand the ethical considerations and responsibilities of statisticians, including confidentiality, integrity, and transparency in statistical practice and research.

PROGRAMME OUTCOMES (PO)

Programme	**B.Sc., Statistics**
Programme Code	**US10**
Duration	**3 years[UG]**
PO1	**Disciplinary Knowledge:** Capable of demonstrating comprehensive knowledge and Understanding of one or more disciplines that form a part of an undergraduate programmedof study.
PO2	**Critical Thinking:** Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge Development.
PO3	**Problem Solving:** Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's earning to real life situations.
PO4	**Analytical Reasoning:** Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints
PO5	**Scientific Reasoning:** Ability to analyze, interpret and draw conclusions from quantitative /Qualitative data; and critically evaluate ideas, evidence, and experiences from an openminded and reasoned perspective.
PO6	**Self-directed & Lifelong Learning:** Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.
PO7	**Lifelong learning:** Ability to acquire knowledge and skills, including, learning how to learn', that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development / re skilling.
PO8	**Moral and ethical awareness/reasoning:** Ability to embrace moral/ethical values in conducting one's life, formulates a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.

PROGRAM SPECIFIC OUTCOMES	
PSO1	Acquire good knowledge and understanding, to solve specific theoretical & applied Problems in different area of statistics.
PSO2	Understand, formulate, develop statistical arguments, logically and use quantitative and qualitative Models to address issues arising in social sciences, business and other context /fields.
PSO3	To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, and beliefs and apply diverse frames of references to decisions and actions. To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential Organizations.

Eligibility for Admission:

Candidate for admission to the first year of **(B.Sc.,Statistics)** Department of Statistics shall be required to have passed the Higher Secondary Examination with (Academic or Vocational Stream) conducted by the Government of Tamil Nadu with Statistics/Mathematics/Business Mathematics and Statistics as one subject.

Methods of Evaluation and Assessment

Methods of Evaluation		
Internal Evaluation		**25 Marks**
External Evaluation	**End Semester Examination**	**75 Marks**
	Total	**100 Marks**
Method of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand / Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate Between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Semester-I						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA11	Tamil-1	4	1	0	0	3
24UFEN11	English-1	4	1	0	0	3
24USTC11	CC–1-Descriptive Statistics	3	1	2	0	5
24USTC12P	CC-2 Statistical Practical-I	0	0	4	0	3
24UMAA17	EC-1AL-Mathematics for Statistics/	2	1	1	0	3
	SEC–1NM-Statistical Methods	1	0	1	0	2
24USTS12	SEC–2Basic Computer (MS Excel)	1	0	1	0	2
24USTF11	FC-Elementary Statistics	1	1	0	0	2
Total					30	23

Semester-II						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
24UFTA21	Tamil-2	4	1	0	0	3
24UFEN21	English-2	4	1	0	0	3
24USTC21	CC–3-ProbabilityTheory	3	1	2	0	5
24USTC22P	CC-4-Statistical Practical-II (Data Analysis using MS Excel)	0	0	4	0	2
24USTA21	EC-2- Applied Statistics	2	1	1	0	4
24USTA22P	EC-3 Statistical Practical–III	0	0	2	0	2
24USTS21	SEC–3 Database Management System	1	0	1	0	2
24UAEC21	AEC–1 Life Skills Through Yoga	1	1	0	0	2
Total					30	23

Semester-III						
24UFTA31	Tamil-3	4	1	0	0	3
24UFEN31	English-3	4	1	0	0	3
24USTC31	CC–5–Distribution Theory	3	2	1	0	5
24USTC32P	CC-6 (Practical)- Statistical Practical-IV	0	0	4	0	2
24UMAA35 24UCSA32	EC-4 AL-1.Numerical Methods 2.Programming in C	2	1	1	0	4
24UMAA35P 24UCSA32P	EC-5 AL (Practical)- 1.Numerical Methods . 2. Programming in C	0	0	2	0	2
24USTS31	SEC -4 R Programming	1	0	1	0	2
24UAEC31	AEC–2 Human Values and Professional Ethics	1	1	0	0	2
Total					30	23

Semester-IV						
24UFTA41	Tamil-4	4	1	0	0	3
24UFEN41	English-4	4	1	0	0	3
24USTC41	CC–7 Sampling Theory	3	1	2	0	5
24USTC42P	CC-8 (Practical)- Statistical Practical-V	0	0	4	0	2
24USTA41 24USTA42	EC-6 AL-1. Python Programming 2. Programming in C++	2	1	1	0	4
24USTA41P 24USTA42P	EC-7 AL (Practical)- 1.Python Programming 2. Programming in C++	0	0	2	0	2
24USTS41	SEC–5 Data Mining	1	0	1	0	2
24UAEC41	AEC–3 Environmental Studies and Disaster Management	1	1	0	0	2
Total					30	23

Semester-V						
24USTC51	CC-9–Estimation Theory	3	1	1	0	4
24USTC52	CC-10-Statistical Quality Control	2	1	1	0	4
24USTC53	CC–11 –Design of Experiments	2	1	1	0	4
24USTC54P	CC-12 Statistical Practical-VI Using R Programming Lab	0	0	3	0	2
24USTE51 24USTE52	EC–8 Operations Research / Discrete Mathematics	2	1	2	0	4
24USTE53 24USTE54	EC–9 Demography / Mathematical Economics	3	1	1	0	4
24UAEC51	AEC – 4 Gender Equality and Social Inclusion	2	0	0	0	2
24USTIN51	Internship					2
24UMAIK51	Indian Mathematics: Tradition to Transformation	1	1	0		
Total					30	26

Semester-VI						
24USTC61	CC–13 Testing of Statistical Hypothesis	3	1	1	0	4
24USTC62P	CC-14 Statistical Practical-VII Using SPSS	0	0	5	0	3
24USTC63P	CC-15- Project	0	0	0	5	4
24USTE61 24USTE62	EC–10 Stochastic Processes/ Indian Official Statistics	3	1	1	0	4
24USTE63 24USTE64	EC–11 Actuarial Statistics/ Financial Analytics	2	1	2	0	4
24UMAP61	PEC–1 Data Visualization using TABLEAU	1	1	1	0	2
24UMAL61	SLC–1 Mathematical Aptitude	0	0	0	2	2
					30	23
Total						141+2*

Students must complete atleast one online course (MOOC)from platforms like SWAYAM, NPTEL, or Nanmudalvan within the fifth semester Additionally, engaging in a specified Self-learning Course is mandatory to qualify for the degree, and successful participation will be acknowledged with an extra credit of 2*.

Part–1 & 2	Tamil & English	4	SEC	Skill Elective Course	5
CC	Core Course	15	FC	Foundation Course	1
EC-AL	Elective Course– Applied	7	AEC	Ability Enhancement Course	4
EC	Elective Course-Major	4	SLC	Self-Learning Course	1

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC11	**CC –I Descriptive Statistics**	**CC**	**3**	**1**	**2**	**0**	**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand fundamental concept of Statistics and statistical data.
LO2	To provide the visualization of diagrammatic & graphical representation of data.
LO3	To apply the measure of central tendency of the distribution.
LO4	To analyze the concept of Measures of Dispersion and their importance.
LO5	To analyze graphical methods of correlation, such as Scatter Diagrams, to visually represent relationships between variables.

Unit	Content	Hours
1	**Introduction of Statistics:** Introduction -Definition-Scope of Statistics -Functions and Limitations of statistics Collection of Data: Primary and secondary data - Methods of collecting primary data - Sources of secondary data-Framing a Questionnaire- Sampling: Census and Sample Methods-Measurement scales.	18
2	**Diagrammatic & Graphical Representation:** Classification-Types - Formation of frequency distribution-Tabulation - parts of a Table - Types. Diagrammatic representation–Types. Graphical representation-Ogives, Lorenz Curve -Merits and Limitations of diagrams and graphs.	18
3	**Measures of Central Tendency:** Introduction-Definitions- Types - Mean-Median-Mode-Geometric mean-Harmonic Mean-Simple Problems-Merits and Demerits	18
4	**Measures of Dispersion, Measures of Skewness and Kurtosis:** Introduction–Definition–Types–Range-Quartile Deviation - Mean deviation - Standard deviation - Co-efficient of variation - Karl Pearson‘s – Bowley‘s - Kelly‘s methods – Their merits and demerits. Kurtosis. Moments: Raw Moments, Central moments Simple problems.	18
5	**Correlation& Regression Analysis:** Introduction - Definition - Types – Ungrouped and Grouped data – Rank correlation- Probable error – Coefficient of determination -Merits and demerits of Correlation-Regression-Regression Equation	18

CO	Course Outcomes **The Student will able to**
CO1	Describe the scope, functions, limitations, collections, sampling, and presentation of data in Statistics
CO2	Apply diagrammatic representations their types and presentation of data
CO3	Analyze the importance and uses of central values for the various types of data
CO4	Understand & analyze the concept of Measures of Dispersion and their importance.
CO5	Apply graphical methods of correlation, such as Scatter Diagrams, to visually represent relationships between variables.
Textbooks:	
1	Gupta S. Cand Kapoor,V.K.(2002).Fundamentals of Mathematical Statistics, Sultan Chand &Sons Pvt. Ltd.,New Delhi
2	Pillai,R.S., and Bagavathi (2003):Statistics, S.Chand and Company Ltd., New Del
Reference Books:	
1	Hogg.R.V and Craig.A.T.(1978):Introduction to Mathematical Statistics, 6th Mc Graw Hill Publishing Co.Inc. NewYork.
2	Hogg.R.V.and Craig.A.T.(1978):*I* Introduction to Mathematical Statistics 7th Mc Graw Hill Publishing Co.Inc.NewYork.
3	Rohatgi,V.K.(1984):An Introduction to Probability Theory and Mathematical Statistics,2nd Edition
Web resources:	
1	https://en.wikipedia.org/wiki/Descriptive_statistics
2	https://statistics.laerd.com/statistical-guides/measures-central-tendency-mean-mode-median.php
3	https://byjus.com/maths/dispersion/
4	https://www.sciencedirect.com/topics/computer-science/correlation-analysis
5	https://www.investopedia.com/terms/r/regression.asp

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	2	3	3	3	3
CO2	2	2	2	2	2	2	3	2	2	2	2
CO3	3	3	3	2	3	2	2	3	3	3	3
CO4	2	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	3	3	3	3	3
Total	14	15	14	13	12	12	12	15	15	15	14
Average	2.8	3.0	2.8	2.6	2.4	2.4	2.4	3.0	3.0	3.0	2.8

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC12P	**CC-2 Statistical Practical I**	**CC**	**0**	**0**	**4**		**3**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand fundamental concept of Statistics and statistical data.
LO2	To provide the visualization of diagrammatic & graphical representation of data.
LO3	To apply the measure of central tendency of the data.
LO4	To analyze the concept of Measures of Dispersion and their methods in real data
LO5	To analyze graphical methods of correlation, such as Scatter Diagrams, to visually represent relationships between variables.

Unit	Content	Hours
1	Construction of Univaraiate, Bivariate frequency distribution	6
2	Diagrammatic Representation	6
3	Graphical Representation	6
4	Measures of Location	6
5	Measures of Dispersion	6
6	Measures of Skewness	6
7	Measures of Kurtosis	6
8	Measures of Kurtosis and Moments	6
9	Computation of Correlation Coefficient	6
10	Spearman’s Rank Correlation	6

CO	Course Outcomes The students will able to
CO1	Understand presentation of data in frequency distribution table
CO2	Apply diagrammatic representations their types and presentation of data
CO3	Analyze the importance and uses of central values for the various types of data.
CO4	Understand & analyze the concept of Measures of Dispersion and their importance.
CO5	Analyze the methods of correlation represent relationships between variables.
Textbooks:	
1	Gupta S. Cand Kapoor,V.K.(2002).Fundamentals of Mathematical Statistics, Sultan Chand &Sons Pvt. Ltd.,New Delhi
2	Pillai,R.S., and Bagavathi (2003):Statistics, S.Chand and Company Ltd., New Delhi.
Reference Books:	
1	Hogg.R.V.and Craig.A.T.(1978):Introduction to Mathematical Statistics, 6th Mc Graw Hill Publishing Co.Inc.NewYork.
2	Hogg.R.V.and Craig.A.T.(1978):*I* Introduction to Mathematical Statistics 7th Mc Graw Hill Publishing Co.Inc.NewYork.
3	Rohatgi,V.K.(1984):An Introduction to Probability Theory and Mathematical Statistics,2nd Edition

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	2	3	3	3	3
CO2	3	3	3	3	2	3	2	2	3	2	2
CO3	2	3	3	2	3	3	2	2	3	3	2
CO4	2	3	3	3	3	3	3	3	3	2	2
CO5	3	3	3	3	2	3	3	3	3	3	3
Total	13	15	15	13	12	15	12	13	15	13	12
Average	2.6	3.0	3.0	2.6	2.4	3.0	2.4	2.6	3.0	2.6	2.4

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTS12	SEC 2 Basic computer	SEC	1	0	1	0	2	2	25	75	100

Learning Objectives	
LO1	To Gain a basic understanding of Microsoft Excel's interface, functionalities, and features.
LO2	To Understand how to apply formatting options such as fonts, colors, borders, and cell alignment.
LO3	To Understand how to organize and manage multiple worksheets and workbooks efficiently.
LO4	To implement data validation rules to ensure data accuracy and consistency.
LO5	To Understand how to customize charts to effectively communicate insights from descriptive analyses

Unit	Content	Hours
1	Introduction to MS Excel - Introduction, Navigating MS Excel, Cells, Rows, and Columns, Formulas, Sheet Tabs, Page Margins, Page Orientation, Page Breaks and Printing. Worksheets and Workbooks: Definition of Worksheets and Workbooks, Naming of Worksheets, Adding and Deleting Worksheets, Hiding/ Un hiding Worksheets, Hiding Columns and Rows, Saving Workbooks, Saving an Existing File.	6
2	Entering & Editing Information - Entering Data, Labels and Values, Copying Cells, Rows and Columns, Pasting Cells, Rows, and Columns, Paste an Item from the Clipboard, Inserting and Deleting Rows and Columns, Filling and Editing Cell Data, Find and Replace, Go to Cell Data, Locking Rows and Columns, Spell Check, AutoCorrect.	6
3	Formatting & Adding Elements to a Worksheet - Change Font Styles and Sizes, Adding Borders and Colors to Cells, change a Column Width and Row Height, Merge Cells, Align Cell Contents, Cell Styles, Conditional Formatting, Freeze and Unfreeze Rows and Columns, Adding and Modifying Images, Cropping and Rotating an image, compressing a Picture, Inserting AutoShapes, Adding WordArt, Clip Art, and a Hyperlink.	6

4	Advance Excel - What if Analysis – Goal Seek, Scenario Analysis, Data Tables, Solver Tool, Logical Function – if, nested if. Lookup Functions – Vlookup / HLookup,	6
5	Data Visualization – Charts Elements, Customizing Layouts & Styles, Formatting Chart Elements, Bar and Columns Chart, Histogram, Pie MS Excel using the Data Analysis Took Pak - Descriptive Statistics in Excel - Central Tendency (Mean, Median, Mode), Variability (Standard Deviation, Variance, Range).	6

CO	**Course Outcomes** **The students will able to**
CO1	Understand the format data efficiently using Excel, including applying cell formatting, borders, colors, and font styles.
CO2	Utilize basic Excel functions such as SUM, AVERAGE, MAX, MIN, and COUNT to perform calculations on data sets.
CO3	Understand and apply Excel's data analysis tools such as sorting, filtering, and conditional formatting to organize and analyze data effectively
CO4	Create various types of charts and graphs in Excel, including bar charts, line graphs, pie charts, and scatter plots, to visualize data trends and relationships.
CO5	Perform advanced data analysis and modeling tasks using Excel's statistical functions and scenario analysis tools.
Text Books:	
1	Beverly Dretzke, Statistics with Microsoft Excel Fourth Edition
2	Neil J.Salkind, Excel Statistics
3	Larry Pace, The Excel Data and Statistics Cookbook, Third Edition
Reference Books:	
1	Kumar Bittu, Microsoft Office 2010
2	Frag Curtis, Step by Step Microsoft Excel 2013
3	John Walkenbach, 101 Excel 2013 Tips, Tricks and Time severs
Web Resources:	
1	https://www.geeksforgeeks.org/introduction-to-ms-excel/
2	https://edu.gcfglobal.org/en/excelxp/enter-edit-and-delete-data/1/
3	https://help.tableau.com/current/pro/desktop/en-us/formatting_worksheet.htm
4	https://in.indeed.com/career-advice/career-development/advanced-excel-skills
5	https://en.wikipedia.org/wiki/Data_and_information_visualization

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	3	3	3	3	3
CO2	3	2	3	3	2	3	3	3	3	3	3
CO3	3	3	3	2	3	2	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3	3
Total	15	13	13	13	12	14	15	15	15	15	15
Average	3	2.6	2.6	2.6	2.4	2.8	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTF11	**FC-1 Elementary Statistics**	**FC**	**1**	**1**	**0**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To enable the students to understand the basic concepts of set theory.
LO2	To acquire knowledge of the Sequence and series of Arithmetic and Geometric. Find useful applications in commercial problems among others.
LO3	To know the difference between permutation and combination for the purpose of arranging different objects
LO4	To Develop the ability to recognize and identify patterns in number series and sequences
LO5	To enable the important concepts of statistical data.

Unit	Content	Hours
1	Introduction of Set Theory – Subset, Types of Sets, Relations, Functions – Simple problems	6
2	Sequence and Series of Arithmetic and Geometric Progressions – Introduction to Sequence, Series, Arithmetic Progression, Geometric Progression – Simple Problems.	6
3	Basic Concepts of Permutations & Combination – Fundamental Principles of Counting, Factorial, Permutations, Circular Permutations, Permutation with Restrictions, Combinations – Simple Problems.	6
4	Logical Reasoning– Number Series, Coding and decoding and odd man out	6
5	Concept of Statistical population and a sample – quantitative and qualitative data- Measurement scales – nominal, ordinal, interval and ratio.	6

CO	Course Outcomes **The students will able to**
CO1	Understand the basic concepts of quantitative ability
CO2	Understand the basic concepts of logical reasoning Skills
CO3	Acquire satisfactory competency in use of reasoning
CO4	Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning Ability.
CO5	Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC,GPSC etc
Text Books:	
1	Agarwal, R. S.A Modern Approach to verbal & Non-Verbal Reasoning
2	Sijwali, B. S. A Analytical and Logical reasoning.
3	Freund, John E., and Perles, Benjamin M. (2019): Modern Elementary Statistics, Pearson Education, 13th Edition.
4	Triola, Mario F. (2017): Elementary Statistics, Pearson Education, 13th Edition.
5	Dr. P.R. Vittal (2012) Allied Mathematics.
Reference Books:	
1	Agarwal, R. S. Quantitative aptitude for Competitive examination.
2	Sijwali, B. S. Analytical and Logical reasoning for CAT
Web Resources:	
1	https://www.math.uh.edu/~dlabate/settheory_Ashlock.pdf
2	http://matematicas.uis.edu.co/adrialba/sites/default/files/SetTheoryDover-%20Charles%20C%20Pinter.pdf
3	https://ncert.nic.in/pdf/publication/exemplarproblem/classXI/mathematics/keep207.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	3	3	3	3	3
CO2	3	2	3	3	2	2	3	3	3	3	3
CO3	3	2	2	2	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	2	3	3	3	3	3	3
Total	15	12	14	13	12	13	15	15	15	15	15
Average	3	2.4	2.8	2.6	2.4	2.6	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC21	CC3 Probability Theory	CC3	3	1	2	0	5	6	25	75	100

Learning Objectives	
LO1	To describe the importance and scope of probability theory and to predict the chance of an experimental outcomes.
LO2	To provide the study of random variable, distribution function.
LO3	To Explore Two-dimensional variables and its distributions.
LO4	To Explore the expected value of a function of a random variable and understand its applications.
LO5	To Understand the concept of Generating functions and characteristic function.

Unit	Content	Hours
1	**Theory of Probability** Introduction-Basic terminology- Definition - Axiomatic approach – Types of Events– Addition and Multiplication theorems of Probability for two events(Statement and Proof) -Conditional Probability –Independent Events-Baye's theorem of Probability (Statement and Proof)-Simple problems	**18**
2	**Random variables and Distribution functions** Introduction - Discrete random variable: Probability mass function-Discrete distribution function, Properties. Continuous random variable: Probability density function –Continuous distribution Function and properties-Simple Problems	**18**
3	**Two dimensional Random variables** Joint probability mass function- Marginal probability function, Conditional Probability function. Two dimensional distribution functions-Marginal distribution functions-Joint density function-Marginal density function-Conditional distribution function-Conditional probability density function only.	**18**
4	**Mathematical Expectations** Introduction- Expected value of a random variable (Discrete and Continuous)-Expected value of function of a random variable - Properties of Expectation-Properties of variance. Covariance. Simple Problems.	**18**
5	**Generating functions** Moment Generating Function-Properties- Cummulant Generating Function-Properties- Probability Generating Function- Properties. Characteristic Function-Properties–Necessary and Sufficient condition - Inversion theorems (Statement only)- Uniqueness theorem (Statement only). Chebychev's Inequality (Statement and Proof).	**18**

CO	Course Outcomes The students will able to
CO1	Understand concepts of probability and identify the different approaches of probability theory
CO2	Apply concept of random variable and its respective probability values and to compare a discrete and continuous random variable.
CO3	Apply how marginal distributions can be extracted from two-dimensional distributions.
CO4	Analyze the expected value of a random variable and variance, covariance of random variable
CO5	Demonstrate the use of generating functions , Inversion& Uniqueness theorem Chebychev's inequality
Text Books:	
1	Gupta S.C. and Kapoor V.K (2015): Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
2	Mood A.M. Gray bill, F.A. and Bose. D.C. (1974): Introduction to the theory of Statistics, McGraw Hill Publishing Co. Inc. New York
3	A.M.Goon, M.K.Gupta & B. Dasgupta (1980): An outline of Statistical theory, Vol. I, 6 th revised, World Press.
4	A.M.Mood, F.A. Graybill and D.C. Boes (1974): Introduction to the theory of Statistics, International student ed. McGraw Hill.
5	Marek Fisz (1961): Probability theory and Mathematical Statistics, John Wiley.
Reference Books:	
1	Hogg. R.V. and Craig. A.T. (1978) :Introduction to Mathematical Statistics, McGraw Hill Publishing Co. Inc. New York.
2	Hogg, R.V. and Craig, A.T. (1998): Introduction to Mathematical Statistics, 4th ed. Academic Press.
3	Rohatgi, V.K. (1984): An introduction to probability theory and mathematical statistics.
4	Sanjay Arora and Bansilal (1989): New Mathematical Statistics, Satya prakashan, New Delhi
5	Murry R. Spiegal (1982): Theory and problems of Probability and Statistics, Schaum's outline series, McGraw Hill
Web Resources:	
1	https://www.coursera.org/browse/data-science/probability-and-statistics
2	https://www.youtube.com/watch?v=sbbYntt5CJk
3	https://oli.cmu.edu/courses/probability-statistics-open-free/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	2	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	2	3	3
CO5	3	3	3	3	2	3	3	3	3	3	3
Total	15	12	14	13	12	13	15	15	15	15	15
Average	3	2.4	2.8	2.6	2.4	2.6	3	3	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC22P	**CC–4 Statistical Practical-II (Data Analysis using MS Excel)**	**CC**	**0**	**0**	**4**	**0**	**2**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand Practical knowledge in, probability theory.
LO2	To apply students with skills to solve problems related to random variables
LO3	To develop proficiency in analyzing random variables and their distribution functions.
LO4	To apply expected values and variance.
LO5	To analyze moment generating function and characteristics function.

Unit	**Content**	**Hours**
1	Problems related to Addition and Multiplication theorem	6
2	Problem related to Conditional Probability and Independence	6
3	Problems related to Bayes Theorem	6
4	Random Variables	6
5	Distribution Functions	6
6	Joint Distribution Function	6
7	Expectation, Variance and Correlation Coefficient	6
8	Moment Generation Function	6
9	Cummulant Generating Function	6
10	Characteristics Function	6

CO	Course Outcomes **The students will able to**
CO1	Analyze problems involving conditional probability and evaluate the independence of events.
CO2	Understand the concept of random variables
CO3	Calculate and interpret statistical measures such as expectation, variance.
CO4	Apply moment and cumulant generating functions to summarize statistical distributions.
CO5	Analyze statistical concepts using MS Excel to organize, compute, and present data effectively.
Text Books:	
1	Gupta S.C. and Kapoor V.K (2015): Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
2	Mood A.M. Gray bill, F.A. and Bose. D.C. (1974): Introduction to the theory of Statistics, McGraw Hill Publishing Co. Inc. New York
3	A.M.Goon, M.K.Gupta & B. Dasgupta (1980): An outline of Statistical theory, Vol. I, 6 th revised, World Press.
4	A.M.Mood, F.A. Graybill and D.C. Boes (1974): Introduction to the theory of Statistics, International student ed. McGraw Hill.
5	Marek Fisz (1961): Probability theory and Mathematical Statistics, John Wiley.
Reference Books:	
1	Hogg. R.V. and Craig. A.T. (1978) :Introduction to Mathematical Statistics, McGraw Hill Publishing Co. Inc. New York.
2	Hogg, R.V. and Craig, A.T. (1998): Introduction to Mathematical Statistics, 4th ed. Academic Press.
3	Rohatgi, V.K. (1984): An introduction to probability theory and mathematical statistics.
4	Sanjay Arora and Bansilal (1989): New Mathematical Statistics, Satya prakashan, New Delhi
5	Murry R. Spiegal (1982): Theory and problems of Probability and Statistics, Schaum's outline series, McGraw Hill.

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	3	3
CO3	3	2	3	3	3	3	3	3	2	3	3
CO4	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	14	14	15	15	15	14	15	14	15	15
Average	3	2.8	2.8	3	3	3	2.8	3	2.8	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTA21	**EC-2 Applied Statistics**	**EC**	**2**	**1**	**1**	**0**	**4**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To Understand the significance of time series and its components.
LO2	To Explore the various methods related to measuring seasonal variations in the data.
LO3	To understand and apply the concepts of Index numbers and its usage.
LO4	Analyze Quantitative Index Numbers and its applications and Study the Classification of Index Number.
LO5	To apply understand the concept of demand, factors influencing consumer demand, and the role of consumer preferences in determining demand.

Unit	Content	Hours
1	Time series - Concept - Components of time Series -Additive and multiplicative Models - Measurement of trend - Free hand method - Semi average method - Moving average method - Least square method- Simple Problems	12
2	Measurement of seasonal variations - Simple average method - Ratio to trend method - Ratio to moving average method - Link relative method-Simple Problems	12
3	Index Numbers - Uses –Basic Problems involved in the Construction of Index Number- Methods of constructing index numbers - Unweighted index numbers - weighted index numbers- Fixed Base Index Number and chain base index numbers- Simple Problems	12
4	The criteria of a Good Index Number -Unit test-Time reversal test - Factor reversal test –Circular Test. Classification of Index Number-Wholesale price Index Number-cost of living index Numbers-Consumer Price Index Number-Limitations of Index Numbers- Simple Problems	12
5	Demand Analysis Theory and analysis of consumer's demand Law of demand, Price elasticity of demand functions and supply – Partial and cross elasticity's of Demand- Simple Problems.	12

CO	Course Outcomes **The students will able to**
CO1	Understand the Time Series concept and Measurement of Trend
CO2	Estimate the Measurement of seasonal variations and its various methods
CO3	Understand and apply the concept and purposes of Index Numbers
CO4	Apply the criteria of a good index numbers and Classification of Index Number.
CO5	Understand the basic concepts of demand, the law of demand, and factors affecting consumer demand.
Text Books:	
1	Kapoor,V.K and Gupta,S.C (1978); Fundamentals of Applied Statistics, Sultan chand & Sons.
2	Mukhopadhyay P.(1999): Applied Statistics, New Central Book Agency Pvt. Ltd., Calcutta.
3	Pillai RSN and Bagavathi V, Statistics,S.Chand & Co.,2010
4	Gupta, S.P (1999): Statistical Methods, Sultan & Sons, New Delhi.
5	Croxton, F.E & Cowdon, D.J. (1973): Applied general statistics, Prentice Hall
Reference Books:	
1	Box, G.E.P., Jenkins, G.M., Reinsel, G.C. and Ljung, G.M. Time Series Analysis: Forecasting and Control, 5th Edition, John Wiley& sons,Inc.,2015.
2	Brockwell,P.J.and Davis, R.A., Introduction to TimeSeries Analysis. Springer, 2003.
3	Srinivasan, K. (1998). Demographic Techniques and Applications. Sage Publications.
4	Srivastava O.S. (1983). A Text Book of Demography. Vikas Publishing House.
5	Garret, H.E., Education and Psychological Statistics, Paragan International Publications, 2005.
Web Resources:	
1	https://www.stat.berkeley.edu/~bartlett/courses/153-fall2010/lectures/1.pdf
2	http://www.gdcboysang.ac.in/About/droid/uploads/EconomicsPart4.pd
3	http://ocw.jhsph.edu/courses/demographicmethods/PDFs/idm-sec1.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	2	3	3	3	2	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	15	13	15	15	15	13	15	14	15	15
Average	3	3	2.6	3	3	3	2.6	3	2.8	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTA22P	**EC-3 Statistical Practical -III**	**EC**	**0**	**0**	**2**		**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To equip with the fundamental methods and techniques for analyzing time series data.
LO2	To provide hands-on experience in calculating and interpreting trend and seasonal variation.
LO3	To construct and apply different index numbers for price and quantity.
LO4	To validate the reliability of index numbers through tests like time reversal and factor reversal.
LO5	To understand the consistency and reliability of index numbers.

Unit	Content	Hours
1	Measurement of Trend	5
2	Measurement of Seasonal Variation	5
3	Constructing Index Numbers	5
4	Quantity Index Number	5
5	Time Reversal Factor Reversal Test	5
6	Classification of index Number	5

CO	Course Outcomes The students will able to
CO1	To identify and analyze trends and seasonal variations in time series data.
CO2	Understand constructing and interpreting different types of index numbers.
CO3	Analyzing quantity index numbers using various methods.
CO4	Understand and apply the time reversal and factor reversal tests to verify index numbers.
CO5	Analyze the ability to classification of index numbers

Text Books:	
1	Kapoor,V.K and Gupta,S.C (1978); Fundamentals of Applied Statistics, Sultan chand & Sons.
2	Mukhopadhyay P.(1999): Applied Statistics, New Central Book Agency Pvt. Ltd., Calcutta.
3	Pillai RSN and Bagavathi V, Statistics,S.Chand & Co.,2010
4	Gupta, S.P (1999): Statistical Methods, Sultan & Sons, New Delhi.
5	Croxton, F.E & Cowdon, D.J. (1973): Applied general statistics, Prentice Hall
Reference Books:	
1	Box, G.E.P., Jenkins, G.M., Reinsel, G.C. and Ljung, G.M. Time Series Analysis: Forecasting and Control, 5th Edition, John Wiley& sons,Inc.,2015.
2	Brockwell,P.J.and Davis, R.A., Introduction to TimeSeries Analysis. Springer, 2003.
3	Srinivasan, K. (1998). Demographic Techniques and Applications. Sage Publications.
4	Srivastava O.S. (1983). A Text Book of Demography. Vikas Publishing House.

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	3	3
CO3	3	2	3	3	3	3	3	3	2	3	3
CO4	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	14	14	15	15	15	14	15	14	15	15
Average	3	2.8	2.8	3	3	3	2.8	3	2.8	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTS21	SEC-3 Database Management System	SEC	1	0	1		2	2	25	75	100

Learning Objectives	
LO1	To Understand the components and functions of a database system, including the database, DBMS and user applications.
LO2	To Identify and enforce constraints in a database design to maintain data integrity.
LO3	To Understand the syntax and semantics of the key operations in Relational Algebra.
LO4	To Understand the equivalence and differences between relational algebra and relational calculus, focusing on their capabilities in terms of query expressiveness.
LO5	To Understanding of constraints and integrity constraints in relational databases, and to enable them to effectively using SQL

Unit	Content	Hours
1	Introduction to Databases and Transactions -What is database system, purpose of database system, view of data, relational databases, database architecture, transaction management.	6
2	Database design and ER Model: Overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas.	6
3	Relational Algebra and Calculus Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics.	6
4	Operators, grouping and ungrouping, relational comparison. Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs. algebra, computational capabilities.	6
5	A constraint, Views and SQL what is constraints, types of constraints, Integrity constraints, SQL: data definition, aggregate function, Null Values, nested sub queries, Joined relations.	6

CO	Course Outcomes The students will able to
CO1	Understand the fundamental components and objectives of a database system.
CO2	Create and interpret ER diagrams for clear and efficient database design.
CO3	Develop skills to formulate database queries declaratively using relational calculus syntax and semantics.
CO4	Analyze the computational capabilities of relational query languages and their impact on database operations.
CO5	Learn to define and manage the structure of relational databases using DDL commands.

Text Books	
1	H.F. Korth and A.Silberschatz (1988): Database system Concept, McGraw Hill Publication.
2	Mc Graw-Hill,Rob,Coronel,“Database Systems”,Seventh Edition,Cengage Learning.
3	Albert Lulushi (1997): Developing ORACLE FORMS Applications, Prentice Hall
4	A Silberschatz,H Korth,S Sudarshan,“Database System and Concepts”,fifth Edition
Reference Books	
1	Ramez Elmasri and B. Navathe, Fundamentals of Database Systems, 3/e, Addison Wesley.
2	Date C.J. (1981). Introduction to Database Systems, Addison-Wesley/
Web Resources:	
1	https://nptel.ac.in/courses/106104135
2	https://onlinecourses.nptel.ac.in/noc20_cs03/preview

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	1	1	1	2	2	1
CO2	3	3	3	1	3	1	1	1	2	2	1
CO3	3	3	3	2	3	1	1	1	2	3	1
3CO4	3	3	3	2	3	1	1	1	3	3	2
CO5	3	3	3	2	3	2	2	1	3	3	2
Total	15	14	14	15	15	15	14	15	14	15	15
Average	3	2.8	2.8	3	3	3	2.8	3	2.8	3	3

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC31	Distribution Theory	Core Course-5	3	2	1	0	5	6	25	75	100

Learning Objectives	
LO1	To understand the fundamental concept of probability distribution, including its types, properties, and how it is used to model random variables
LO2	To apply the essential properties of discrete distribution
LO3	To evaluate normal distribution and its characteristics, such as symmetry, mean, and the empirical rule
LO4	To explore the uniform and exponential distribution
LO5	To evaluate the concept of Gamma distribution & Beta distribution including its properties.

Unit	Content	Hours
1	Introduction to Probability distribution-Bernoulli distribution-Binomial distribution – moments-moment generating function-characteristic function-Additive properties of Binomial Distribution -cumulants -Simple Problems. Poisson distribution – moments-moment generating function-characteristic function- Additive properties of Poisson distribution –cumulants-Simple Problems	18
2	Negative binomial distribution – moment generating function-Cumulants. Geometric distribution – lack of memory-moments-moment generating function - Hyper geometric distribution – mean and variance of the Hyper geometric distribution– Multinomial distribution –mean and variance.	18
3	Normal Distribution – chief characteristics of the normal distribution-median-mode –Moments-moment generating function-Cumulants -points of inflexion,Area property -Importance of Normal Distribution. Simple Problems.	18
4	Exponential distribution – moment generating function- characteristic function, memory less property –Rectangular Or Uniform Distribution-Moments- Moment Generating function- Characteristics function-Simple Problems	18
5	Gamma distribution – moment generating function and cumulants and central moments-Additive property of Gamma distribution (reproductive property) – Beta distribution – First kind and second kind – constants.	18
Total		90

Theory-80% Problem-20%

CO	Course Outcomes **The student will be able to**
CO1	Apply the fundamental concept of probability distributions, identify and differentiate between various types Probability distribution.
CO2	Analyze the nature of various probability distributions, including geometric and hyper geometric distributions, to solve real-world problems.
CO3	Derive the properties of Normal distribution in continuous probability distribution
CO4	Apply Exponential & Uniform distribution and its characteristics
CO5	Analyze the Gamma and Beta distributions including their properties
Textbooks:	
1	Gupta S.C.and Kapoor V.K(2015):Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
2	A.M.Goon,M.K.Gupta &B.Dasgupta(1980):An outline of Statistical theory,Vol.I,6th revised, World Press.
Reference Books:	
1	Hogg.R.V.and Craig.A.T.(1978):Introduction to Mathematical Statistics, 6th Mc Graw Hill Publishing Co.Inc.NewYork
2	Hogg.R.V.and Craig.A.T.(1978):*I* Introduction to Mathematical Statistics 7th Mc Graw Hill Publishing Co.Inc.NewYork.
3	Rohatgi,V.K.(1984):An Introduction to Probability Theory and Mathematical Statistics,2nd Edition
Web resources:	
1	https://www.geeksforgeeks.org/discrete-probability-distribution
2	https://www.knime.com/blog/continuous-probability-distribution
3	https://www.scribbr.com/statistics/probability-distributions

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	3	3	3	3
CO2	3	3	3	2	2	2	2	2	3	2	2
CO3	3	3	3	2	3	3	2	3	3	3	3
CO4	3	3	3	2	3	2	2	2	3	3	2
CO5	3	3	3	2	3	2	2	2	3	3	3
Total	15	15	15	10	14	12	10	12	15	14	13
Average	3	3	3	2	2.8	2.4	2	2.4	3	2.8	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC32P	Statistical Practical-IV	Core Practical-6	0	0	4	0	2	4	25	75	100

Learning Objectives	
LO1	To understand and apply Probability distribution and its concept.
LO2	To fit the various distribution model in discrete distribution.
LO3	To gain practical knowledge of Normal distribution.
LO4	To understand practical knowledge in exponential and beta distribution
LO5	To apply Gamma and Beta distribution and its concepts.

	Content	Hours
	1. Binomial distribution 2. Fitting a Binomial distribution 3. Poisson Distribution 4. Fitting a Poisson Distribution 5. Normal distribution 6. Fitting a Normal distribution 7. Exponential distribution 8. Uniform distribution 9. Gamma Distribution 10. Beta distribution of First kind & Second kind	60
Total		60
Problems-100%		

CO	Course Outcomes The student will be able to
CO1	Understand and analyze discrete probability distributions, and to compute the mean and variance to make informed decisions based on probabilistic models.
CO2	Apply continuous probability distributions, and to calculate their mean and variance in order to analyze and interpret real-world data and make informed decisions.
CO3	Create the practical applications of the χ^2 (chi-square) statistic in real-life problems, such as testing hypotheses, analyzing categorical data, and evaluating the goodness of fit in various fields like market research, medicine, and social sciences.
CO4	Apply the concepts of Uniform and Exponential distributions to model real-life phenomena
CO5	Analyze the nature and applications of distributions such as the Gamma and Beta distributions, understanding their characteristics, and applying them to model various real-life situations
Textbooks:	
1	Gupta S.C.and Kapoor V.K(2015):Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
2	A.M.Goon,M.K.Gupta &B.Dasgupta(1980):An outline of Statistical theory,Vol.I,6th revised,WorldPress.
Reference Books:	
1	Hogg.R.V.and Craig.A.T.(1978):Introduction to Mathematical Statistics, 6th Mc Graw Hill Publishing Co.Inc. NewYork.
2	Hogg.R.V.and Craig.A.T.(1978):*I* Introduction to Mathematical Statistics 7th Mc Graw Hill Publishing Co.Inc.NewYork.
3	Rohatgi,V.K.(1984):An Introduction to Probability Theory and Mathematical Statistics,2nd Edition

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	3	3	3	3
CO2	3	3	3	2	2	2	2	2	3	2	2
CO3	3	3	3	2	3	3	2	3	3	3	3
CO4	3	3	3	2	3	2	2	2	3	3	2
CO5	3	3	3	2	3	2	2	2	3	3	3
Total	15	15	15	10	14	12	10	12	15	14	13
Average	3	3	3	2	2.8	2.4	2	2.4	3	2.8	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAA35	Numerical Methods	Elective Course -4	2	1	1	0	4	4	25	75	100

Learning Objectives	
LO1	To develop Solution of Numerical Algebraic and Transcendental Equations.
LO2	To introduce the study of Simultaneous Linear Algebraic Equations and Finite differences.
LO3	To acquire the knowledge on central difference interpolation formula for Equal intervals.
LO4	To analyze applications on Newton's divided difference formula and Lagrange's interpolation Formula
LO5	To evaluate derivatives using Newton's forward and backward differences formulae and numerical integration.

Unit	Content	Hours
1	**The Solution of Numerical Algebraic and Transcendental Equations** Iteration Method, Regular Falsi Method, Newton–Raphson Method. **Chapter 1: Sections 1.2 to 1.4**	12
2	**Solution of Simultaneous Linear Algebraic Equations** Gauss – Elimination Method, Gauss–Jordan Method, Gauss –Jacobi Method. **Finite Differences:** Operators**, Interpolation for Equal intervals:** Newton's Forward Interpolation Formula and Newton's Backward Interpolation Formula. **Chapter: Sections 2.1 to 2.2,2.5,** **Chapter 3: Sections 3.1** **Chapter 4: Sections 4.1,4.2,4.3**	12
3	**Central Difference Interpolation Formula for Equal Intervals** Gauss Forward Interpolation Formula, Gauss Backward Interpolation Formula, Sterling's Formula. **Chapter5: Sections 5.1 to5.5**	12
4	**Interpolation with Unequal Intervals** Divided Differences, Newton's Divided Differences Interpolation Formula, Lagrange's Interpolation Formula and Inverse Lagrange's Interpolation. **Chapter6:Sections 6.1,6.2,6.5& 6.7**	12
5	**Numerical Differentiation** Numerical Differentiation based on Newton's Forward and Backward Interpolation Formula. **Numerical Integration:** General Quadrature formula for equidistant ordinates, Trapezoidal Rule, Simpson's 1/3rd Rule, Simpson's 3/8th Rule. **Chapter 7: Sections 7.1 to 7.3,7.7 to 7.9,7.13 to 7.14**	12
	Total	**60**

Theory-80% Problem-20%

CO	Course Outcomes The student will be able to
CO1	Compute derivatives on Numerical Algebraic and Transcendental Equations
CO2	Find Solutions of Simultaneous Linear Algebraic Equations and Interpolation.
CO3	Understand the need of interpolation
CO4	Work on numerical methods to approximate derivatives by applying Newton's forward and backward differences formulae.
CO5	Get Knowledge of advanced numerical differentiation and numerical integration techniques
Textbooks:	
1	P.Kandasamy and K.Thilagavathy, Calculus of Finite differences & Numerical Analysis, S. Chand & Company Ltd., New Delhi, 2003.
Reference Books:	
1	H.C.Saxena, Finite differences and Numerical analysisS.Chand&Co.,Delhi,1991.
2	M.K.Venkataraman, Numerical methods for Science and Engineering National Publishing Company,Chennai,1992.
3	T.K.Manicavachagom Pillay and Narayanan, Numerical Analysis, Viswanathan (Printers /Publishers) Pvt.Ltd, 1994.
4	Dr.B.S.W.Goel, Numerical Analysis, Chand off set Printer, Chennai
5	B.D.Gupta, Numerical Analysis, Konark Pub.Ltd,Delhi,2001.
Web resources:	
1	https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus//
2	https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004//

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	2	3	3	3	3
CO5	3	2	2	2	3	2	3	3	3	3	3
Total	15	14	14	14	14	14	14	15	15	15	15
Average	3.0	2.8	2.8	2.8	2.8	2.8	2.8	3.0	3.0	3.0	3.0

3–Strong, 2-Medium, 1-Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAA35P	Practical - Numerical Methods	Elective Practical 5	0	0	2	0	2	2	25	75	100

Learning Objectives	
LO1	To learn Newton–Raphson Method, Gauss Elimination Methods and Gauss–Jacobi Method.
LO2	To work on Newton's Forward Interpolation Formula and Backward Interpolation Formula
LO3	To analyze Lagrange's Interpolation, Newtons Forward Formula for Derivatives.
LO4	To understand Trapezoidal Rule.
LO5	To understand Simpson's 1/3rd Ruleand Simpson's 3/8th Rule.

	Content	Hours
	1. Newton–Raphson Method. 2. Gauss Elimination Methods. 3. Gauss–Jacobi Method. 4. Newton's Forward Interpolation Formula. 5. Newton's Backward Interpolation Formula. 6. Lagrange's Interpolation. 7. Newtons ForwardF ormula for Derivatives. 8. Trapezoidal Rule. 9. Simpson's1/3rdRule. 10. Simpson's3/8thRule.	30
	Total	30
	Problem 100%	

CO	Course Outcomes The student will be able to
CO1	Find the roots of Newton–Raphson Method, Gauss Elimination and Gauss–Jacobi Method
CO2	Interpolate methods and understand methods.
CO3	Calculate Lagrange's Interpolation, Newtons Forward Formula for Derivatives.
CO4	Understand the method and applying to approximate area and evaluating its accuracy.
CO5	Work on problems in Simpson's1/3rdRuleand3/8thRule.
Textbooks:	
1	P.Kandasamy and K.Thilagavathy, Calculus of Finite differences & Numerical Analysis, S.Chand&Company Ltd., New Delhi, 2003
Reference Books:	
1	H.C. Saxena, Finite differences and Numerical analysis S. Chand & Co., Delhi, 1991.
2	M.K. Venkataraman, Numerical methods for Science and Engineering National Publishing Company,Chennai, 1992
3	T.K. Manicavachagom Pillay and Narayanan, Numerical Analysis, Viswanathan (Printers /Publishers) Pvt. Ltd, 1994.
4	Dr. B.S.W. Goel, Numerical Analysis, Chand offset Printer, Chennai
5	B.D .Gupta ,Numerical Analysis, Konark Pub.Ltd, Delhi, 2001.
Website and e-learning source	
1	https://ocw.mit.edu/courses/22-15-essential-numerical-methods-fall-2014/pages/syllabus/
2	https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2004/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	2	3	3	3	3
CO5	3	2	2	2	3	2	3	3	3	3	3
Total	15	14	14	14	14	14	14	15	15	15	15
Average	3.0	2.8	2.8	2.8	2.8	2.8	2.8	3.0	3.0	3.0	3.0

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCSA32	Programming in C	Elective Course - 4	2	1	1	0	4	4	25	75	100

Learning Objectives	
LO1	To understand Programming basics and the fundamentals of C.
LO2	To apply Data types in C, Mathematical and logical operations, Using control statement and loops
LO3	To analyze Arranging data in arrays with algorithm
LO4	To explore Learning the functions parameters Implementing
LO5	To apply Pointers and file operations

Unit	Content	Hours
1	Introduction to Programming: Introduction to computers, Computer characteristics, Hardware vs software, Steps to develop a program, Software development life cycle, Structured programming, Types of programming languages, Introduction to c, Developing a c program, Console input and output functions, Error diagnostics, Debugging techniques	12
2	Operators and Expressions: Identifiers and keywords, Data types, Constants, Variables, Declarations, Expressions, Statements, Arithmetic operators, Unary operators, Relational and logical operators, Assignment operators, Conditional operator Branching, if- else statement, which statement, go to statement, Looping, while statement, do- while statement, for statement, Nested control structures, break statement, continue statement.	12
3	Arrays and Strings: Defining an array, Processing an array, Multidimensional arrays, Searching algorithm, Linear search, Sorting algorithm, Bubble sort algorithm, Strings, Defining a string, Initialization of strings, Reading and writing a string, Processing the strings.	12
4	Functions: Functions, Overview, Defining a function, Accessing a function, Function prototypes, Passing arguments to a function, Passing arrays to functions, Recursion. Pointers and Structures: Fundamentals, Pointer declarations, Passing pointers to functions, Structure & Union	12
5	File system : Types of file, working with files, File Handling, file operation, Sequential and Random Access Files. Standard I/O Functions: fscanf(), fprintf(), fgets(), fputs(), Command Line Arguments.	12
Total		60

Theory 80% Problem 20%

CO	Course Outcomes The student will be able to
CO1	Understand basic Structure of the C-Programming, declaration and usage of variable
CO2	Develop conditional and iterative statements to write C programs
CO3	Implement arrays and strings in your C program.
CO4	Apply code reusability with functions
CO5	Programs that use Pointers to access arrays, strings and functions.
Textbooks:	
1	Byron Gottfried, "Schaum's Outline of Programming with C", 3rd edition, 2016, McGraw Hill Education (India), ISBN: 9780070145900
2	Let Us C: Authentic guide to C programming language - 19th Edition – 15 December 2022 by Yashavant Kanetkar
3	A Textbook of Basics of C Programming – 2020 - Vikash Kumar Gupta, ISBN: 978-93-87394-89-6
4	Programming in C KTU [EST 102] Paperback – 26 April 2022 by Vijitha RobinsonKailas SreeChandran
Reference Books:	
1	C Programming Books for Beginners and Advanced By jasdeepbhatia| December 26, 2023
2	C Programming Language, 2nd Edition by Brian W. Kernighan, Dennis Ritchie Released 1988
3	Programming in C ,Stephen G. Kochan, Third Edition
Web resources:	
1	www.w3schools.com/
2	www.javatpoint.com/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	2	3	3	2	2	3	3
CO3	3	2	3	3	3	3	3	3	3	2	2
CO4	3	3	3	3	2	3	3	2	2	3	3
CO5	3	2	3	3	3	3	3	3	3	2	2
Total	15	12	15	15	13	15	15	13	13	12	12
Average	3	2.4	3	3	2.6	3	3	2.6	2.6	2.4	2.4

3–Strong, 2-Medium, 1-Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UCSA32P	Practical-Programming in C	Elective Practical-5	0	0	2	0	2	2	25	75	100

Learning Objectives	
LO1	To introduce students to the basic knowledge of programming fundamentals of C language
LO2	To impart writing skill of C programming to the students and solving problems.
LO3	To impart the concepts like looping, array, functions, pointers, file, structure
LO4	To impart the concepts like looping, array, functions, pointers, file, structure
LO5	To impart the concepts like looping, array, functions, pointers, file, structure

	Content	Hours
	1. Write a Program to calculate and display the volume of a CUBE having its height (h=10cm), width (w=12cm) and depth (8cm). 2. Write a program to take input of name, roll no and marks obtained by a student in 4 subjects of 100 marks each and display the name, roll no with percentage score secured. 3. Write a Program to perform the arithmetic expression using switch statement. 4. Write a program to generate all prime numbers up to nth number. 5. Program to print product of two matrices. 6. Program to concatenate two strings without using library functions. 7. Program to find factorial of a given number using function. 8. Find Square Root, numerical differentiation, numerical integration using functions and recursion. 9. Program to print the elements of array using pointers. 10. Implementation of Text Processing using Strings	30
Total		**30**
Problem 100%		

CO	Course Outcomes **The student will be able to**
CO1	Understand the logic for a given problem. Write the algorithm of a given problem.
CO2	Recognize and understand the syntax and construction of C programming code.
CO3	Learn the methods of iteration or looping and branching
CO4	Make use of different data-structures like arrays, pointers, structures and files
CO5	Write programs to printout put on the screen as well as in the files.
Textbooks:	
1	Byron Gottfried, "Schaum's Outline of Programming with C",3rd edition, 2016, Mc Graw Hill Education (India), ISBN:9780070145900
2	Let Us C:Authentic guide to C programming language-19th Edition–15 December 2022 by Yashavant Kanetkar
3	A Textbook of Basics of C Programming – 2020 -Vikash Kumar Gupta, ISBN: 978-93-87394-89-6
4	Programming in CKTU [EST102] Paperback–26 April 2022 by Vijitha Robinson(Kailas Sree Chandran
5	ByronGottfried,"Schaum's Outline of Programming with C",3rd edition,2016,Mc Graw Hill Education (India), ISBN:9780070145900
Reference Books:	
1	C Programming Books for Beginners and Advanced By jasdeepbhatia | December26,2023
2	C Programming Language, 2nd Edition by Brian W. Kernighan, Dennis Ritchie Released March 1988
3	Programming in C, Stephen G.Kochan, Third Edition
Web resources:	
1	https://www.w3schools.com/
2	https://www.tpointtech.com/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	2	3	3	2	2	3	3
CO3	3	2	3	3	3	3	3	3	3	2	2
CO4	3	3	3	3	2	3	3	2	2	3	3
CO5	3	2	3	3	3	3	3	3	3	2	2
Total	15	12	15	15	13	15	15	13	13	12	12
Average	3	2.4	3	3	2.6	3	3	2.6	2.6	2.4	2.4

3 – Strong, 2- Medium, 1- Low

II YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTS31	R Programming		1	0	1	0	2	2	25	75	100

Learning Objectives	
LO1	To learn the fundamental concepts of 'R' using R Gui and R Studio
LO2	To understand the special data structures of R language Character Vector, Array, Matrix and List
LO3	To provide knowledge for various control structures
LO4	To provide knowledge in Data types and packages
LO5	To understand about graphical analysis pie and bar charts

Unit	Content	Hours
1	Introduction: History of R- Benefits of Using R – Working with code Editor: RGui and R Studio - Starting your First R Session - Sourcing a script - Navigating the workspace- Vectors: Creating vectors- combing vectors repeating vector - Getting values in and out of vectors- working with logical vectors	6
2	Using character vector for text data - Manipulating text - Factoring in Factors - Naming matrix rows and columns - Calculating with matrices- Creating an array- Creating a list Creating a list - Extracting elements from lists - Changing elements in lists	6
3	Control Structures: Conditional control structures: if statement - if..else statement - switch statement - Loops: for, while and repeat loops - break and next statement. Functions: The Function Keyword - Arguments - Return Values- Computing basic statistics: mean, median, mode, correlation and covariance.	6
4	Getting data into and out of R: Working with other data types - Getting your data out of R - Working with Files and Folders. Packages: Finding packages, installing packages, loading packages, updating package and unloading packages.	6
5	Introduction to Graphical Analysis: Box-Whiskers plots - Scatter plots - Pairs plots - Line charts - Pie charts - Bar charts: single category bar chats and multiple category bar charts.	6
	Total	**30**

	Theory-100%

Course Outcomes	
CO	**The student will be able to**
CO1	Understand the basics of R programming
CO2	Work with vectors and matrices
CO3	Acquire the knowledge of various control structures
CO4	Parse data files using built-in functions
CO5	Apply the various statistical functions and produce high quality graphics
Text books:	
1	Andrie Devries And Jorismeys , "R Programming For Dummies", Wiley Publications, Isbn:978-81-265-5201-6. (Unit 1 : chapter-2,3,4) (Unit 4: chapter 12,14) (Unit 2 chapter 5,6,7)
2	Tilman M .Davis “The Book of R”, No Starch Press, 2016 (Unit 3: chapter 10,11,3)
3	Paul Teetor, "R Cook Book",O'relly Publications, First Edition, 2011, Isbn: 978-0-596-80915-7 (Unit 5: Chapter 10)
4	Alex Nordeen, Learn R Programming In 24 Hours: Complete Guide For Beginners, Guru99, 2020.
5	Dr.Mark Gardener, "Beginning R- The Statistical Programming Language", Wiley Publications, Isbn: 978-81-265-4120-1.
Reference Books:	
1	Joseph Adler, "R In Nutshell A Desktop Quick Reference",Isbn:978-0-596- 80170-0
2	Roger D. Peng, "R Programming For Data Science", Leanopub, 2015
3	Matloff, Norman, And Matloff, Norman S, The Art Of R Programming: A Tour Of Statistical Software Design, No Starch Press, 2011
4	Lovelace, Robin, And Gillespie, Colin. Efficient R Programming: A Practical Guide to Smarter Programming, O'reilly Media, 2016.
5	Jeeva Jose, Beginner's Guide For Data Analysis Using R Programming., Khanna Publishing House,2019
Web Resources:	
1	https://www.tutorialspoint.com/r/index.htm
2	https://www.youtube.com/watch?v=_V8eKsto3Ug
3	https://www.youtube.com/watch?v=SYYUBytX1ng

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	3	3	3	3
CO2	3	3	2	2	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	2	2	1
CO4	3	2	3	3	3	2	3	3	2	2	2
CO5	3	3	3	2	3	3	3	3	3	3	3
Total	15	14	14	13	14	14	13	15	13	13	12
Average	3	2.8	2.8	2.6	2.8	2.8	2.6	3	2.6	2.6	2.4

3 – Strong, 2- Medium, 1- Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC41	**Sampling Theory**	**Core**	**3**	**2**	**1**		**5**	**6**	**25**	**75**	**100**

Learning Objectives	
LO1	To introduce the fundamental principles and practices of sample surveys.
LO2	To provide a comprehensive understanding of Simple Random Sampling (SRS) techniques and their statistical properties.
LO3	To learn the principles of stratified Random sampling, related notations, and how to estimate population parameters and their variances.
LO4	To learn how to estimate population parameters using systematic samples and evaluate their sampling variance.
LO5	To know how to select samples with unequal probabilities, understand PPS sampling with and without replacement, and estimate population totals and their variances.

Unit	**Content**	**Hours**
1	Introduction of Sampling-Parametric & Statistic-Basic concepts of sample surveys – Advantages of Sampling –Principal steps in Sample survey, Sampling unit – Sampling frame – Census– Probability Sampling and Non-probability sampling	18
2	Simple random sampling, Methods of selection, Sampling with and Without replacement – Properties of estimates, Variance of the Estimates Finite population correction, Estimation of Standard error, Confidence limits -Simple random sampling with replacement-Qualitative characteristics, Sample size determination for proportions and continuous data.	18
3	Stratified random sampling, principles of stratification, Notations –Estimation of population mean and its variance – Estimated variance and confidence limits, Allocation techniques -equal allocation, proportional allocation, Neymann allocation and optimum allocation, Relative Precision of Stratified random and Simple Random sampling-Estimation of gain due to stratification.	18
4	Systematic sampling –Relation to cluster sampling, Estimation of population mean and its sampling variance – Comparison of systematic Sampling with stratified random samples	18
5	Varying Probability sampling, Selection of one unit with PPS, PPS Sampling with replacement, Estimator for population total and its variance, Selection procedures.	18
	Total	**90**

Theory 80% Problem 20%

CO	Course Outcomes The students will be able to
CO1	Understand the basic concepts of sample surveys and explain their role in statistical data collection and analysis.
CO2	Apply appropriate methods of selecting Simple Random Sampling.
CO3	Understand the principles of stratified random sampling and explain the rationale for stratification in survey design.
CO4	Explain the concept and methodology of Systematic Sampling**,** and how it is implemented in practice.
CO5	Understand the principles of varying probability sampling and its importance in survey methodology.
Text books:	
1	1. Cochran, W.G. (1978) : Sampling Techniques, John Wiley Eastern
2	Singh. D. and Chaudry F.S. (1986) : Theory and Analysis of Sample Surveys Design Wiley Eastern Ltd.
Reference Books:	
1	Gupta S.C. and Kapoor V.K (2007) : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
Website and e-Learning Source	
1	http://ocw.jhsph.edu/courses/statmethodsforsamplesurveys/pdfs/ lecture2.pdf
2	https://www.questionpro.com/blog/stratified-random-sampling/
3	https://www.scribbr.com/methodology/systematic-sampling

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	3	3	3	3
CO2	3	3	3	3	2	2	2	2	3	2	2
CO3	3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	2	3	2	2	2	3	3	2
CO5	3	3	3	2	3	2	2	2	3	3	3
Total	15	15	15	12	14	12	10	12	15	14	13
Average	3	3	3	2.4	2.8	2.4	2	2.4	3	2.8	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC42P	**Statistical Practical-V**	**Core Practical**	**0**	**0**	**4**	**0**	**2**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To introduce the fundamental concepts and principles of probability sampling methods of simple random Sampling.
LO2	To develop understanding of procedures for drawing samples from a population with and without replacement.
LO3	To explain the estimation of population parameters such as mean, total, and variance using various sampling designs.
LO4	To enable students to analyze and compare the efficiency of different sampling techniques based on their variances and standard errors.
LO5	To provide an understanding of varying probability sampling methods, particularly Probability Proportional to Size (PPS) sampling, and to develop the ability to estimate population totals and their variances using appropriate selection procedures.

	Content	**Hours**
I	**Simple Random sampling** Drawing Sample from the Population with Replacement Drawing Sample from the Population without Replacement. Estimation of Population Mean. Estimation of Total Variance and its Standard Error.	15
II	**Stratified random Sampling** Estimation of Mean Variance of the Population Means Variance of the estimator of Mean under Proportional and Optimal allocations	15
III	**Systematic random sampling** Estimation of Mean and Variance Comparison of Simple Random Sampling, Stratified Random Sampling and Systematic Random Sampling	15
IV	**Varying Probability sampling**, Selection of one unit with PPS, PPS Sampling with replacement, Estimator for population total and its variance, Selection procedures.	15
	Total	**60**
	Practical-100%	

CO	Course Outcomes The Student will able to
CO1	Apply simple random sampling techniques to select samples and estimate population parameters with and without replacement..
CO2	Compute estimates of population mean, total, and variance along with their standard errors under different sampling methods.
CO3	Apply stratified random sampling and evaluate estimators under proportional and optimal allocation schemes.
CO4	Apply systematic random sampling to estimate population mean and variance and assess its relative efficiency.
CO5	Interpret PPS sampling techniques with and without replacement to select representative samples and accurately estimate population totals and their variances.
Text Book	
1	Cochran, W.G. (1978) : Sampling Techniques, John Wiley Eastern
2	Singh. D. and ChaudryF.S. (1986) : Theory and Analysis of Sample Surveys Design Wiley Eastern Ltd.
Reference Book	
1	Gupta S.C. and Kapoor V.K (2007) : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	3	3	3	3
CO2	3	3	3	2	2	2	2	2	3	2	2
CO3	3	3	3	2	3	3	2	3	3	3	3
CO4	3	3	3	2	3	2	2	2	3	3	2
CO5	3	3	3	2	3	2	2	2	3	3	3
Total	15	15	15	10	14	12	10	12	15	14	13
Average	3	3	3	2	2.8	2.4	2	2.4	3	2.8	2.6

3 – Strong, 2- Medium, 1- Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTA41	**Python Programming**	**Elective**	**2**	**1**	**1**	**0**	**4**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the concepts of Operators, Expression, Data types and its Operations.
LO2	To Understanding Decision Making, Looping statements and Functions.
LO3	To Identify and use Python's core data types: Numbers, Strings, Lists, Tuples, Sets, and Dictionaries.
LO4	To Construct various types of graphs and diagrams in python
LO5	To compute and interpret descriptive statistical measures—such as central tendency, dispersion, skewness, correlation, and regression—using Python for data analysis.

Unit	Content	Hours
1	**Basics of Python Programming:** History of Python – Features of Python– Literal – Constants – Variables – Identifiers – Keywords – Comments – Indentation – Operators – Expressions - Type conversions.	12
2	**Flow Control:** Decision Making – if Statement – if else statement– if elif else statement – Nested if statement – Loops – for loop – for loop with else statement – while loop– while loop with else statement– Nested loop – Control statements – Function Definition – Function calling– Function Arguments – Anonymous Function – Recursive Function.	12
3	**Modules and Packages:** Built - in Modules – Creating Modules– Import Statement – Locating Modules – Namespaces and Scope– The dir() function – The reload() function – Packages in Python – Data and Time Modules . Data Types and Operations: Numbers – Strings – List – Tuple – Set – Dictionary.	12
4	**Visualizing Data With Graphs:** Understanding the Cartesian Coordinate Plane– Creating Graphs with Matplotlib – Marking Points on your Graphs–Simple bar diagram, Multiple bar diagram, subdivided bar diagram,Pie diagram,Scatter plot, Histogram, Box plot.	12
5	**Descriptive Statistics with Python:** Measures of central Tendency-Finding Mean, Median–Mode and Creating a Frequency Table– Measures of Dispersion, Skewness–Range-quartile-deviation-Standard-deviation-Pearsons skewness– Calculating the correlation and Regression	12

	Total	**60**
	Theory 80% Problem 20%	

CO	**Course Outcomes** The students can able to
CO1	Write simple programs on python using Expression and Data Types.
CO2	Develop program using Control flow statements
CO3	Create and manage reusable Python code through the use of modules and packages.
CO4	Apply Matplotlib tools to create and customize a variety of graphical representations of data.
CO5	To apply Python programming to calculate, visualize, and interpret key descriptive statistics, correlations, and simple regression relationships within real-world datasets.
Textbooks:	
1	Jeeva Jose, "Taming Python by Programming", Revised Edition, Khanna Publishing, 2019.ISBN :978-93-86173-34-8. (Unit - 1 to 3)
2	Amit Saha "Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus, and More!" Publisher: William Pollock (Unit - 4 & 5)
Reference Books:	
1	VamsiKurama,"Python Programming:A Modern Approach",Pearson Education.
2	Ashok Kamthaneet.al,Programming and Problem Sovling with Python, 2nd Edition,TMH
3	ReemaThareja, "Python Programming using problem solving approach", First Edition, 2017,Oxford University Press
Web Resources:	
1	https://www.programiz.com/python-programming
2	https://www.guru99.com/python-tutorials.html
3	https://www.youtube.com/watch?v=ev3CPFYOKcc

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	3	2	2	2	2	3
CO2	3	3	2	3	2	3	2	3	3	3	2
CO3	2	3	2	3	3	2	2	3	3	3	2
CO4	3	2	2	3	3	3	3	3	3	3	3
CO5	3	3	2	3	3	3	2	3	3	3	2
Total	14	14	10	15	13	14	11	14	14	14	12
Average	3	3	2	3	3	3	2.2	3	3	3	2

3 – Strong, 2- Medium, 1- Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTA41P	**Python Programming Lab**	**Elective Practical**	**0**	**0**	**2**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To Understand and apply Python programming concepts to manipulate various data types such as strings, lists, tuples, sets, and dictionaries.
LO2	To Develop modular and efficient programs using Python operators, expressions, and user-defined functions.
LO3	To i Visualize and interpret data effectively using graphical representations such as line charts, bar charts, pie charts, scatter plots, and other plots with the Matplotlib library.
LO4	To Apply descriptive statistical techniques in Python to compute measures of central tendency, dispersion, and skewness for data analysis.
LO5	To Analyze and model relationships between variables using correlation and regression methods to support data-driven insights and predictions.

	List of Programs	**Hours**
	1. Write a program to explore String 2. Write a program to explore List 3. Write a program to explore Set 4. Write a program to explore Tuple 5. Write a program to explore Dictionaries Functions. 6. Write a program to demonstrate usage Operators 7. Write a program to demonstrate usage Functions 8. Write a program to drawing Line Chart and Bar Chart using Mat plot lib. 9. Write a program to drawing Multiple bar chart using Mat plot lib 10. Write a program to drawing Subdivided bar chart using Mat plot lib 11. Write a program to drawing Pie chart using Mat plot lib 12. Write a program to drawing Pie chart using Mat plot lib 13. Write a program to drawing Scatter using Mat plot lib 14. Write a program to demonstrate Measures of Central Tendancy (Mean. Median & Mode) 15. Write a program to demonstrate Measures of Dispersion (Range,Quartile Deviation, Standard Deviation) 16. Write a program to demonstrate Measures of Skewness 17. Write a program to demonstrate Correlation 18. Write a program to demonstrate Regression	30
	Total	**30**

Problem 100%

CO	Course Outcomes The students will able to
CO1	Apply Python programming concepts to manipulate fundamental data types such as strings, lists, tuples, sets, and dictionaries effectively.
CO2	Demonstrate the use of operators and user-defined functions to develop modular and efficient Python programs.
CO3	Utilize the Matplotlib library to visualize data through various graphical representations including line charts, bar charts, pie charts, scatter plots, and other statistical plots.
CO4	Perform descriptive statistical analysis using Python to compute measures of central tendency, dispersion, and skewness.
CO5	Analyze relationships between variables through correlation and regression techniques, and interpret results for data-driven decision-making.
Textbooks:	
1	Jeeva Jose, "Taming Python by Programming", Revised Edition, Khanna Publishing, 2019.ISBN :978-93-86173-34-8. (Unit - 1 to 3)
2	Amit Saha "Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus, and More!" Publisher: William Pollock (Unit - 4 & 5)
Reference Books:	
1	VamsiKurama,"Python Programming:A Modern Approach",Pearson Education.
2	Ashok Kamthaneet.al,Programming and Problem Sovling with Python, 2nd Edition,TMH
Web Resources:	
1	https://www.programiz.com/python-programming
2	https://www.guru99.com/python-tutorials.html
3	https://www.youtube.com/watch?v=ev3CPFYOKcc

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	2	2	2	3
CO2	3	3	2	3	2	3	2	3	3	3	2
CO3	2	3	3	3	3	2	3	3	3	3	2
CO4	3	2	2	3	3	3	3	3	3	3	3
CO5	3	3	2	3	3	3	2	3	3	3	2
Total	14	14	12	15	13	14	13	14	14	14	12
Average	3	3	2.4	3	3	3	3	3	3	3	2

3 – Strong, 2- Medium, 1- Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTA42	**Programming in C++**	**Elective**	**2**	**1**	**1**	**0**	**4**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To be able to explain the difference between object-oriented programming and procedural programming.
LO2	To be able to apply object-oriented techniques to solve bigger computing problems.
LO3	To be able to program using C++ features such as composition of objects, operator overloading, inheritance and polymorphism, file I/O, etc.
LO4	To be able to build C++ classes using appropriate encapsulation and design principles.
LO5	To use File Handling and Standard Template Library (STL)

Unit	Content	Hours
1	**Introduction to Object Oriented Programming**-Basic Concepts of OOP, Basic Elements of C++: Tokens, Keywords, Identifiers, Variables, Basic Data Types in C++, Operators in C++.Decision and Control Structures: if Statement, if-else Statement, switch Statement, while, do-while, for.	12
2	**Functions in C++:** The Main Function, Function Prototyping, Call by Reference, Call by Value, Inline Function, Function Overloading- Classes and Objects: Specifying a Class, Defining Member functions, Nesting of Member Functions, Static Data Member and Member Function, Friend Function.	12
3	**Constructors and Destructors**: Constructors, Default Constructor, Parameterized Constructor, Constructor Overloading, Copy Constructor, and Destructor. Operator Overloading: Defining Operator Overloading, Overloading Unary Operators and Overloading Binary Operators.	12
4	**Inheritance**: Introduction, Defining Derived Class, Single Inheritance, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance. Virtual Functions: Virtual Function, Pure Virtual Functions.	12
5	**Working with Files**: Introduction, Classes for File Stream Operations, Opening and Closing a File, Detecting end-of-file, Sequential Input and Output Operations, Updating a File: Random Access, Error Handling During File Operations, Command Line Arguments.	12
	Total	**60**

Theory 80% Problem 20%

CO	Course Outcomes The students will able to
CO1	Explain the difference between object-oriented programming and procedural programming.
CO2	Understand the Program using C++ features such as composition of objects, operator overloading, inheritance and polymorphism, file I/O, etc.
CO3	Apply Build C++ classes using appropriate encapsulation and design principles.
CO4	Apply object-oriented techniques to solve bigger computing problems.
CO5	Analyze Implement and debug efficient C++ programs to solve complex problems.
Textbooks:	
1	E. Balagurusamy - Object-Oriented Programming with C++ - Tata McGraw Hill Publishing Company Limited, 4th Edition.
Reference Books:	
1	Bjarne Stroustrup - The C++ Programming Language, Addison-Wesley, 4th Edition, 2013.
2	Robert Lafore - Object-Oriented Programming in C++, Sams Publishing, 4th Edition, 2002.
Web Resources:	
1	https://cplusplus.com/doc/tutorial/#google_vignette

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	2	3	3	2	2	2	2
CO3	3	3	3	3	3	2	2	2	3	3	3
CO4	3	3	3	3	3	2	2	2	3	3	3
CO5	3	3	3	3	3	2	2	3	3	3	2
Total	15	15	15	15	14	12	12	12	14	13	12
Average	3	3	3	3	2.8	2.4	2.4	2.4	2.8	2.6	2.4

3 – Strong, 2- Medium, 1- Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTA42P	**Practical-Programming in C++ Lab**	**Elective Practical**	**0**	**0**	**2**	**0**	**2**	**2**	**25**	**75**	**100**

Learning Objectives		
LO1	To students will practice using switch statements for decision-making based on user input.	
LO2	To the students will learn how to use pointers to manipulate variables directly in C++.	
LO3	To students will learn how to create multiple functions with the same name but different parameter types, improving code readability and usability.	
LO4	To students will learn about different types of inheritance in C++, enhancing their understanding of object-oriented programming (OOP) principles.	
LO5	To students will learn how to use integrators with std::vector, which is crucial for traversing and manipulating elements in C++ STL containers.	
	Content	**Hours**
	1. Write a C++ program to demonstrate Class and Objects. 2. Write a C++ program to demonstrate function overloading. 3. Write a C++ program to demonstrate the Friend Functions. 4. Write a C++ program to demonstrate Parameterized Constructor, Copy Constructor and Destructor. 5. Write a program to demonstrate operator overloading for Unary operator. 6. Write a program to demonstrate operator overloading for Binary operator. 7. Write a C++ program to demonstrate: a)Single Inheritance •Multilevel Inheritance • Multiple Inheritance b)Hierarchical Inheritance. 8. Write a C++ program to demonstrate Virtual Functions. 9. Write a C++ program to perform Sequential I/O Operations on a file. 10. Write a C++ program to find the Biggest Number using Command Line Arguments.	30
	Total	**30**
	Problem 100%	

CO	Course Outcomes The Students will able to
CO1	Know concepts in operator overloading, function overloading & polymorphism.
CO2	Write, compile and debug programs in C++ language.
CO3	Design programs involving constructors, destructors.
CO4	Reuse of code using inheritance.
CO5	To implement the concept of files, templates and exceptions.
Textbooks:	
1	E. Balagurusamy - Object-Oriented Programming with C++ - Tata McGraw Hill Publishing Company Limited, 4th Edition.
Reference Books:	
1	Bjarne Stroustrup - The C++ Programming Language, Addison-Wesley, 4th Edition, 2013.
2	Robert Lafore - Object-Oriented Programming in C++, Sams Publishing, 4th Edition, 2002.
Web Resources:	
1	https://cplusplus.com/doc/tutorial//

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	2	3	3	2	2	3	3
CO3	3	2	3	3	3	3	3	3	3	2	2
CO4	3	3	3	3	2	3	3	2	2	3	3
CO5	3	2	3	3	3	3	3	3	3	2	2
Total	15	12	15	15	13	15	15	13	13	12	12
Average	3	2.4	3	3	2.6	3	3	2.6	2.6	2.4	2.4

S-Strong-3 M-Medium-2 L –Low

II YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTS41	Data Mining	Skill Enhancement Course	1	0	1	0	2	2	25	75	100

Learning Objectives	
LO1	To provide foundational knowledge on data mining concepts, functionalities, and data warehousing techniques.
LO2	To study the architecture of data mining systems, query languages, and the process of data generalization and summarization.
LO3	To learn the basic concepts and algorithms for mining association rules from large databases.
LO4	To understand classification and prediction methods including decision tree induction and Bayesian classification.
LO5	To study the concepts and methodologies of cluster analysis, including partitioning, hierarchical, density-based, and grid-based methods.

Unit	Content	Hours
1	Introduction: Data mining – Functionalities – Classification – Introduction to Data Warehousing – Data Preprocessing: Preprocessing the Data – Data cleaning – Data Integration and Transformation – Data Reduction.	6
2	Data Mining, Primitives, Languages and System Architecture: Data Mining – Primitives – Data Mining Query Language, Architecture of Data mining Systems. Characterization and Comparison: Concept Description, Data Generalization and Summarization.	6
3	Mining Association Rules: Basic Concepts – Single Dimensional Boolean Association Rules From Transaction Databases, Multilevel Association Rules from transaction databases.	6
4	Classification and Prediction: Introduction – Issues – Decision Tree Induction – Bayesian Classification	6
5	Cluster Analysis: Introduction – Types of Data in Cluster Analysis, Partitioning Methods – Hierarchical Methods-Density Based Methods-Grid based methods – Outlier and Outliers analysis –Outliers Detection Methods	6
	Total	**30**
	Theory-100%	

CO	Course Outcomes The students will be able to
CO1	Understand the basic concepts and functionalities of data mining and data warehousing.
CO2	Explain the architecture of data mining systems and use data mining query languages effectively.
CO3	Analyze and generate association rules from large datasets.
CO4	Apply classification and prediction techniques such as decision tree and Bayesian methods to real-world problems.
CO5	Demonstrate understanding of clustering concepts and apply different clustering algorithms to group data.

Text books:	
1	Han and M. Kamber, "Data Mining Concepts and Techniques", 2001, Harcourt India Pvt. Ltd, New Delhi.
2	P.Rizwan Ahmed, Data Mining, Margham Publications, Chennai, 2012
3	Data Mining Techniques, Arun K Pujari, University Press
4	Data Mining: Concepts and Techniques, 3rd Edition, Jiawei Han, MichelineKamber, Jian Pei
Reference Books:	
1	K.P. Soman, Shyam Diwakar, V. Ajay "Insight into Data Mining Theory and Practice ", Prentice Hall of India Pvt. Ltd, New Delhi
2	Parteek Bhatia, 'Data Mining and Data Warehousing: Principles and Practical Techniques', Cambridge University Press, 2019
Web Resources:	
1	https://www.geeksforgeeks.org/data-science/data-mining/
2	https://www.geeksforgeeks.org/machine-learning/association-rule/

Mapping with Programme Outcomes and Programm Specific Outcome

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	3	2	2	2	2	2
CO2	2	2	2	3	2	2	2	2	2	3	2
CO3	2	2	2	3	1	2	2	2	2	3	3
CO4	3	3	3	3	1	3	3	2	3	3	2
CO5	2	3	3	3	2	2	3	3	3	3	3
Total	12	12	10	14	8	12	12	11	12	14	12
Average	2	2	2	3	2	2	2	2	2	3	2

S-Strong-3 M-Medium-2 L-Low-1

III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC51	Estimation Theory	Core	3	1	1	0	4	5	25	75	100

Learning Objectives	
LO1	To introduce the fundamental concepts of estimation theory, including the formulation and problems associated with estimating population parameters.
LO2	To derive unbiased estimation and its properties in Statistical Inference.
LO3	To analyze and compare the properties of estimators obtained through various estimation methods.
LO4	To introduce the concept of interval estimation**,** including confidence intervals for population parameters such as mean, proportion.
LO5	To understand the fundamental concepts of sampling distributions**,** including Chi-square, Student's t, and F distributions.

Unit	Content	Hours
I	Introduction of Estimation theory- Point Estimation - Problem of Point estimation - Properties of estimators - Consistency and Efficiency of an estimator. Sufficiency of a statistic - Neyman - Fisher factorization theorem (discrete case).	15
II	Unbiasedness - Properties, MVUE, BLUE, Rao - Blackwell theorem - Sufficiency and completeness, Lehman - Scheffe theorem, Cramer - Rao inequality - simple problems.	15
III	Methods of estimation: Method of Moments, Method of Maximum Likelihood, Method of minimum chi-square, method of least squares -properties of estimators obtained by these methods.	15
IV	Interval Estimation - Confidence Interval for proportions, mean(s), variance, and variance ratio based on chi square, student's t, F and Normal distributions.	15
V	Introduction of Sampling Distribution-Concept-Sampling Distribution: Chi-square, Students't and F Distribution-Derivation of their density functions and their properties. Applications Chi- square, Students' t and F Distribution.	15
	Total	**75**

Theory-80% Problems-20%

CO	Course Outcomes **The students will be able to**
CO1	Explain the concepts of point estimation, including the formulation of estimators and their properties like consistency and efficiency.
CO2	Identify sufficient and complete statistics and explain their significance in estimation.
CO3	Analyze and compare estimators based on statistical properties.
CO4	Evaluate and construct confidence intervals for population means, proportions, variances, and variance ratios.
CO5	Derive the probability density functions of Sampling distributions and use in practical applications.
Recommended Text book:	
1	Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2014.
Reference Books:	
1	Hogg R.V. and Craig, A.T.: Introduction to Mathematical Statistics, 3rd edition, Academic Press, USA, 1972.
2	Goon, A.M. Gupta, M.K., and Das Gupta, B.: An outline of Statistical Theory, Volume-.I, 6th revised ed. World Press limited, Calcutta, 1980.
Website and e-Learning Sources:	
1	https://www.statlect.com/fundamentals-of-statistics/point-estimation
2	https://www.geeksforgeeks.org/machine-learning/unbiased-estimator/
3	https://www.geeksforgeeks.org/maths/interval-estimation/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	3	3	3	3
CO2	3	2	3	3	2	2	2	2	3	2	2
CO3	3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	2	3	2	2	2	3	3	2
CO5	3	3	3	2	3	3	2	2	3	3	3
Total	15	13	15	12	14	13	10	12	15	14	13
Average	3	2.6	3	2.4	2.8	2.6	2	2.4	3	2.8	2.6

3 – Strong, 2- Medium, 1- Low

III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC52	Statistical Quality Control	Core	2	1	1	0	4	4	25	75	100

Learning Objectives	
LO1	To understand the fundamental concepts of Statistical Quality Control (SQC) including causes of variation, control charts, and quality-related terminologies.
LO2	To apply the construction and purpose of variable control charts such as X-chart, R-chart, and S-chart in process monitoring.
LO3	To learn how to monitor and control quality by analyzing defects and defectives using appropriate control chart techniques.
LO4	To develop the ability to design and analyze single and double sampling plans for decision-making in quality control and industrial applications.
LO5	To determine sample size and acceptance constant and to construct the Operating Characteristic curve for one-sided specification plans.

Unit	Content	Hours
I	**Statistical Quality Control**: Introduction of Statistical Quality Control-Importance and need for Statistical Quality Control techniques in Industry – Causes of variations in Quality – Uses of Shewart‘s Control charts – Terminologies: Specification limits, Tolerance limits, 3 σ limits.	12
II	**Control charts variables**: Control Chart for Mean (X bar- Chart), Range Chart (R-Chart), Standard Deviation Chart (S-Chart).Interpretation of Control charts X cahrts and R charts.	12
III	**Control Charts for Attributes**: Control Chart for Fraction Defective (p-Chart) Control Chart for Number of Defectives (np-Chart). Control Charts for Defects: Control Chart for Number Of Defects (C-Chart)	12
IV	**Acceptance sampling plans for attributes**: Acceptance Quality level AQL), Lot Tolerance Percent Defective (LTPD), Producer‘s Risk, Consumer‘s Risk AOQ, AOQL, ATI and ASN. Single and Double sampling plans.	12
V	**Acceptance sampling plan for variables**: Acceptance sampling for variables known and unknown sampling plans (one sided specification only) -Determination of n and k for one sided specification of OC curve	12
	Total	**60**
	Theory-80% Problems-20%	

CO	Course Outcomes The Student will be able to
CO1	Explain the concept of Statistical Quality Control (SQC) and its role in maintaining product quality in industries.
CO2	Interpret X and R charts to identify out-of-control conditions and take appropriate corrective actions for quality improvement.
CO3	Apply p-chart, np-chart, and c-chart to analyze process variation and identify out-of-control conditions in quality control.
CO4	Design and evaluate single and double sampling plans for attributes, and select appropriate plans based on quality requirements.
CO5	Construct and interpret the OC curve for one-sided variable acceptance sampling plans to evaluate producer's and consumer's risks.
Recommended Text Book:	
1	Gupta S.C. and Kapoor V.K: Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi, 2007.
Reference Books:	
1	Hoel, P.G.: Introduction to mathematical Statistics, Asia publishing house, 1971.
2	Grant, E,L. and Laven Worth, R.S.: Statistical Quality Control, McGraw Hill.
3	Ekambaram, S K.: Statistical basis of Acceptance sampling, Asia Publishing House, 1963.
4	Douglas C. Montgomery: Introduction to statistical Quality Control, John wiley & Sons, New York, 2005.
Website and e-Learning Sources	
1	https://www.slideshare.net/slideshow/statistical-quality-control-introduction/249242178
2	https://egyankosh.ac.in/bitstream/123456789/20756/1/Unit-2.pdf
3	https://egyankosh.ac.in/bitstream/123456789/20758/1/Unit-3.pdf
4	https://egyankosh.ac.in/bitstream/123456789/20768/1/Unit-5.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	3	3	3	3
CO2	3	3	3	2	2	2	2	2	3	2	2
CO3	3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	2	2	2	3	3	2
CO5	3	3	2	2	3	2	2	2	3	3	3
Total	15	15	14	12	14	12	10	12	15	14	13
Average	3	3	2.8	2.4	2.8	2.4	2	2.4	3	2.8	2.6

3 – Strong, 2- Medium, 1- Low

III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC53	**Design of Experiments**	**Core**	**2**	**1**	**1**	**0**	**4**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the basic principles of experimental design and the methods
LO2	To provide knowledge of Analysis of Variance (ANOVA) for analyzing experimental data and testing the significance of treatment effects.
LO3	To develop the ability to analyze experimental data using ANOVA and interpret treatment effects under different design such as CRD, RBD & LSD.
LO4	To apply the concept of missing plot techniques in experimental design.
LO5	To interpret the concept of factorial experiments such as 2^2 ,2^3 and 3^2factorial designs

Unit	**Content**	**Hours**
I	Fundamental Principles of Experiments – Replication, Randomization and Local Control techniques – Size of experimental unit – Methods of determination of experimental units – (Maximum curvature method – Fairfield Smith‘s variance law).	12
II	Analysis of variance – One way classification, Twoway classification (without interaction) – Multiple range test – Duncan‘s multiple range test – Tukey‘s test.	12
III	Completely Randomized Design (CRD) and its analysis – Randomized block design (RBD) – RBD – More than one but equal number of observations per cell – Latin Square Design (LSD) and its analysis.	12
IV	Missing plot techniques – Meaning – Least Square method of estimating one missing observation of RBD and LSD – Two missing observations in RBD. Analysis of covariance technique in CRD and RBD (without derivation).	12
V	Factorial experiment – Definition – 2^2 ,2^3 and 3^2factorial experiments and their analysis – Principles of confounding – Partial and complete confounding in2^3 – Split plot design and its analysis	12
	Total	**60**
	Theory- 70% Problem-30%	

CO	Course Outcomes **The students can be able to**
CO1	Explain the concept and importance of Design of experiments.
CO2	Apply Analysis of Variance (ANOVA) to analyze experimental data and interpret the significance of treatment effects.
CO3	Perform ANOVA, interpret results, and draw valid conclusions from experimental data in CRD, RBD (with equal replications), and LSD.
CO4	Estimate missing values using least squares in RBD and LSD
CO5	Apply factorial experiment techniques to estimate main and interaction effects, including confounding in designs.
Recommended Text Books:	
1	Gupta S.C. and Kapoor V.K: Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi, 2007.
2	Das, M.N and Giri N.C: Design and Analysis of Experiments, Wiley Eastern,New Delhi, 1979.
Reference Books:	
1	Kempthorne: Design and Analysis of Experiments, John Wiley, New York, 1956.
2	Montgomery.D.: Design of Experiments, John Wiley, New York, 1985.
Website and e-Learning Sources	
1	https://anjali-shukla.medium.com/basic-principles-of-design-of-experiments-e265ae2497fa
2	https://www.geeksforgeeks.org/data-science/analysis-of-variance-anova/
3	https://home.iitk.ac.in/~shalab/anova/chapter8-anova-factorial-experiment.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	2	2	2	3
CO2	3	3	2	3	2	3	2	3	3	3	2
CO3	2	3	3	3	3	2	2	3	3	3	2
CO4	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	3	3	2	3	3	3	2
Total	14	14	12	15	13	14	11	14	14	14	12
Average	2.8	2.8	2.4	3	2.6	3	2.2	2.8	2.8	2.8	2.4

3 – Strong, 2- Medium, 1- Low

III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC54P	**Statistical Practical-VI using R Programming Lab**	**Core Practical**	**0**	**0**	**3**	**0**	**2**	**3**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the fundamental principles of estimation theory.
LO2	To study various control charts (X, R, p, np, and c charts) for analyzing process variation in variables and attributes.
LO3	To apply the concept of Analysis of Variance and apply ANOVA to test the significance of differences between multiple group means.
LO4	To Learn methods to estimate missing observations and ensure valid statistical analysis
LO5	To develop skills in conducting experiments and analyzing data using factorial designs and ANOVA techniques.

	List of Programs	**Hours**
1	**Estimation Theory** Construction of Confidence Interval for mean and variance	9
2	**Statistical Quality Control** Control Charts for Variables (X Bar charts and Range Charts) Control Charts for Attributes (p – charts, np-charts and C-chart)	9
3	**Analysis of Variance** One way classification Two way classification **Design of Experiments** Completely Randomized Design (CRD) Randomized Block Design (RBD) Latin Square Design (LSD)	9
4	**Missing Plot Techniques** One Missing Observation in RBD Two Missing Observation in RBD One Missing Observation in LSD	9
5	**Factorial Experiments** 2^2 Factorial Experiments 2^3 Factorial Experiments 3^2 Factorial Experiments	9
	Total	**45**

Problem 100%

CO	Course Outcomes The students will be able to
CO1	Apply estimation methods to determine unknown parameters in statistical and signal processing problems.
CO2	Construct and interpret control charts (X, R, p, np, and c charts) to determine whether a process is under statistical control.
CO3	Perform one-way and two-way ANOVA to analyze data and test the significance of different treatments in experiments
CO4	Solve practical problems involving missing observations and correctly estimate treatment effects to maintain the reliability of statistical conclusions.
CO5	Analyze 2^2, 2^3, and 3^2 factorial experiments to determine main and interaction effects of factors.
Recommended Text Books:	
1	Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2014.
2	Gupta S.C. and Kapoor V.K: Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi, 2007.
3	Das, M.N and Giri N.C: Design and Analysis of Experiments,Wiley Eastern, New Delhi, 1979.
Reference Books:	
1	Kempthorne,: Design and Analysis of Experiments, John Wiley, New York.,1956.
2	Ekambaram, S K.: Statistical basis of Acceptance sampling, Asia Publishing House, 1963.

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	2	2	2	3
CO2	3	3	2	3	2	3	2	3	3	3	2
CO3	2	3	3	3	3	2	2	3	3	3	2
CO4	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	2	3	3	3	2	3	3	3	2
Total	14	14	12	15	13	14	11	14	14	14	12
Average	2.8	2.8	2.4	3	2.6	3	2.2	2.8	2.8	2.8	2.4

3 – Strong, 2- Medium, 1- Low

III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTE51	**Operations Research**	**Elective**	**2**	**1**	**2**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives		
LO1	To understand fundamental knowledge of Operations Research, including its principles, nature, scope, and importance in decision-making.	
LO2	To develop the ability to solve Linear Programming Problems using the Simplex method and Big M method.	
LO3	To apply the concepts of transportation and assignment problems, including techniques to obtain initial feasible and optimal solutions.	
LO4	To explain the basic concepts and techniques of Network Analysis using CPM and PERT**,** including constraints, network construction, and time calculations.	
LO5	To learn IPR concepts to identify and protect intellectual property.	
Unit	**Content**	**Hours**
I	Introduction to Operations Research, Nature, Scope, Functions-Concept of Linear programming problem(LPP) - Formulation of Linear Programming Problem - Solving the LPP by graphical method.	15
II	Linear Programming Problem-Slack variable - surplus variable - Solving the LPP by simplex method - artificial variable - Big-M method.	15
III	Transportation problem - obtaining initial, feasible and optimal solutions. Optimality test degeneracy, Unbalanced transportation problem. Assignment problem, unbalanced assignment problem - Traveling salesman problem.	15
IV	Network analysis by CPM / PERT basic concepts - constraints in Network - construction of the network - Time calculations - Concepts of three floats in Network Analysis – finding optimum project duration and minimum project cost, finding expected project time and variance	15
V	Introduction to intellectual Property rights (**IPR)**, Patenting – Factors for Patentability – Novelty, Non-Obviousness, Marketability. Procedures for registration of Patents. Copyright works, Ownership, Transfer and Duration of copyright. Renewal and Termination of copyright. Industrial Designs – Need for Protection of Industrial designs. Procedure for obtaining design protection. Infringement, right of goodwill, passing off.	15
	Total	**75**
Theory 40 % Problem 60%		

CO	Course Outcomes The students will be able to
CO1	Explain the basic concepts and principles of Operations Research and its role in managerial decision-making.
CO2	Solve Linear Programming Problems using the Simplex method and Big-M method and interpret the optimal solution.
CO3	Apply optimization techniques to solve Transportation and assignment Problems, interpreting practical solutions.
CO4	Analyze CPM and PERT techniques to construct project networks, compute floats, and determine project duration.
CO5	Understand basics of IPR, patents, copyright, and design protection.
Recommended Text books:	
1	Kanti Swarup et al: Operations Research, sultan chand and Sons, New Delhi.
2	Sharma J.K.: Operations Research. Theory and applications, Macmillan India Ltd, 2001.
3	Elad Harison, Intellectual property rights, Innovation and software technologies. Edward Elgar Publishing Limited, UK, 2008 (Unit -V).
Reference Books:	
1	Frederick S.Hillier & Gerald J.Lieberman: Operations Research, CBS publishers & Distributors, Delhi, 1987.
2	F.S. Hitler and Liberman: Operations Research,CBS Publishers and Distributions, New Delhi, 1994.
Website and e-Learning Sources	
1	https://www.bbau.ac.in/dept/UIET/EMER-601%20Operation%20Research%20Queuing%20theory.pdf
2	https://www.pnw.edu/wp-content/uploads/2020/03/attendance5-1.pdf
3	https://www.mmmut.ac.in/News_content/11235dep-notice_11072020.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	2	3	3	2	2	2	2
CO3	3	3	3	3	3	2	2	2	3	3	3
CO4	3	3	3	3	3	2	2	2	3	3	3
CO5	3	3	3	3	3	2	2	3	3	3	2
Total	15	15	15	15	14	12	12	12	14	13	12
Average	3	3	3	3	2.8	2.4	2.4	2.4	2.8	2.6	2.4

3 – Strong, 2- Medium, 1- Low

III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTE52	Discrete Mathematics	Elective	2	1	2	0	4	5	25	75	100

Learning Objectives	
LO1	To solve recurrence relations and use generating functions.
LO2	To understand basic concepts of mathematical logic and truth tables.
LO3	To analyze logical statements using replacement process and duality law.
LO4	To constrain the structure and properties of lattices.
LO5	To apply Boolean algebra and Karnaugh maps for simplification.

Unit	Content	Hours
1	**Recurrence Relations and Generating Functions:** Recurrence - Polynomials and their Evaluations - Recurrence Relations - Solution of Finite Order Homogeneous [linear] Relations - Solutions of Non-homogeneous Relations. **Chapter: 5 Section: 1 - 5**	15
2	**Mathematical Logic:** TF Statements - Connectives - Atomic and Compound Statements - Well-formed [Statement Formulae]- Truth Table of a Formula- Tautology -Tautological Implications and Equivalence of Formulae. **Chapter: 9 Section: 1 - 8**	15
3	**Mathematical Logic [Contd...]** Replacement process - Functionally complete sets of connectives and Duality law – Normal Forms Principal Normal Forms. **Chapter: 9 Section: 9 - 12**	15
4	**Lattices:** Lattices - Some properties of Lattices - New Lattices - Modular and Distributive Lattices **Chapter: 10 Section: 1 - 4**	15
5	**Boolean Algebra:** Boolean Algebra - Boolean Polynomials- Karnaugh Maps **Chapter: 10 Section: 5 - 7**	15
Total		**75**

Theory 80% problem 20%

CO	Course Outcomes The Students will be able to
CO1	Solve recurrence relations and apply generating functions to discrete problems.
CO2	Analyze and apply concepts of mathematical logic, including truth tables, equivalence.
CO3	Construct and validate mathematical proofs with logical reasoning and Principle normal forms clarity.
CO4	Understand and apply concepts of lattices and their properties.
CO5	Apply Boolean algebra and Karnaugh maps to simplify logical expressions.
Recommended Text Book:	
1	M.K. Venkataraman, N. Sridharan and N. Chandrasekaran, Discrete Mathematics, The National Publishing company, Chennai, 2003.
Reference Books:	
1	Oscar Levin, Discrete Mathematics, 3rd Edition, 2016.
2	B. A. Davey & H. A. Priestley, Introduction to Lattices and Order (2nd edition), Cambridge University Press, 2002.
3	Edgar G. Goodaire& Michael M. Parmenter, Discrete Mathematics with Graph Theory (3rd edition), Pearson Education, 2018.
4	Rudolf Lidl & Günter Pilz, Applied Abstract Algebra (2nd edition), Springer, 1998.
5	C. L. Liu, Elements of Discrete Mathematics (2nd edition), McGraw-Hill, 1985.
Website and e-Learning Sources	
1	https://nptel.ac.in//
2	https://stevengann.com/posts/Boolean-Reduction/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	3	3	2	3	3	3
CO2	3	2	2	2	3	3	3	3	2	2	2
CO3	2	2	2	2	3	3	3	2	3	3	3
CO4	3	2	2	3	3	3	2	3	3	3	3
CO5	3	2	2	3	3	2	2	3	3	3	2
Total	13	11	10	14	15	14	13	13	14	14	13
Average	2.6	2.2	2	2.8	3	2.8	2.6	2.6	2.8	2.8	2.6

3 – Strong, 2- Medium, 1- Low

III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTE53	**Demography**	**Elective**	**3**	**1**	**1**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand various sources of demographic data such as Civil Registration, Population Census, survey data, and statistical models.
LO2	To study demographic methods to analyze fertility, mortality, and population structure.
LO3	To apply the structure and construction of a Life Table and the relationship between its functions for analyzing survival and mortality patterns.
LO4	To Estimate migration using vital statistics method.
LO5	To Identify the components of population growth and change and the stages of Demographic Transition theory

Unit	**Content**	**Hours**
I	Sources of Demographic data - Civil Registration - Population Census registers – Statistical model-Survey-Errors in Demographic data - Methods of Improvement.	15
II	Fertility and Mortality measurements – general and specific rates – standardized rates – age pyramid of sex composition gross and net reproduction rates	15
III	Life table – structure – construction – relationship between the function of a life table – abridged life table – population estimation – growth rates – gross and net reproduction rates component method of population projection – forces of mortality Theories	15
IV	Spatial distribution of population –migration – kinds of migration – factors important in migration analysis – migration defining period and boundary – migration data by vital statistics and survival ratio and National Growth rate methods	15
V	Components of population growth and change – Demographic transition theory – Methods of population projection – component method of projection, Leslie matrix, Logistic curve and its graduation	15
	Total	**75**
	Theory 80% Problem 20%	

CO	Course Outcomes The Students will be able to
CO1	Identify and differentiate sources of demographic data including civil registration, census, surveys, and statistical models.
CO2	Calculate and interpret general and specific fertility and mortality rates, standardized rates, and reproduction rates.
CO3	Construct and interpret life tables, including abridged life tables, and analyze relationships between life table functions.
CO4	Analyze different types of migration and identify factors influencing population movement.
CO5	Apply population projection methods including component method, Leslie matrix, and logistic curve fitting for estimating future population trends.
Recommended Text books:	
1	M.L.Jhingan B.K.Bhatt and J.N.Desai, Demography 3rd edition,Vrindra Publication (P) Ltd, Delhi
2	Roli Missra, Shambahavi Mishra and Nagendra Kumar Maurya.,Demography and Population studies, theory and Techniques and Policy, PHI Learning private Ltd, 2026.
Reference Books:	
1	Pathak K.B and Ram F: Techniques of Demography, wiley Eastern, 1992.
2	Spieglemen, M.: Introduction to Demography, Harvard University Press , 1968.
3	Srivastava, O.S: A text book Demography, Vikas Publishing , 1983.
4	Gupta, S.C. and V.K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand & Sons, 1978.
5	Bogue, Donald, J: Principles of Demography, John Wiley, New York., 1976.
Website and e-Learning Sources	
1	https://www.slideshare.net/slideshow/demography-238374767/238374767
2	https://ecoholics.in/measures-of-demography/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	2	3	3	2	2	3	3
CO3	3	2	3	3	3	3	3	3	3	2	2
CO4	3	3	3	3	2	3	3	2	2	3	3
CO5	3	2	3	3	3	3	3	3	3	2	2
Total	15	12	15	15	13	15	15	13	13	12	12
Average	3	2.4	3	3	2.6	3	3	2.6	2.6	2.4	2.4

S-Strong-3 M-Medium-2 L –Low

III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTE54	**Mathematical Economics**	**Elective**	**3**	**1**	**1**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives	
LO1	To Understand the fundamental concept of basics of Mathematical Economics.
LO2	To explain the fundamental concepts of supply, utility, demand–supply relationship.
LO3	To develop problem-solving skills in evaluating cost–revenue relationships and applying profit and revenue maximization techniques in practical situations.
LO4	To introduce different market structures and their characteristics.
LO5	To analyze homogeneous, Cobb–Douglas, and C.E.S. production functions for studying production efficiency and input–output relationships.

Unit	Content	Hours
I	Scope and methods of Mathematical Economics - Laws of demand , Demand schedule (Individual and Market) - Demand function - Factors influencing the demand - Exception to the law of demand - Elasticity of demand with respect to price and income - Factors affecting the elasticity of demand - Partial elasticity of demand with respect to price - Simple Problems in elasticity of demand	15
II	Supply - Factors affecting the supply of a commodity - Relation between demand and supply - Utility - Concept of utility - Concept of human wants - Maximization of utility – Marginal and total utility - Law of diminishing marginal utility - Indifference curves and map - Properties of indifference curve - Price line.	15
III	Cost Analysis - Different types of cost - Total, average and marginal cost functions – Relation between average and marginal costs - Problems related to total, average and marginal costs -Revenue - Total, average and marginal revenue functions and their relationship – Simple problems related to maximization of total revenue	15
IV	Market Structure - Definition of Market - Perfect completion - Pure competition – Monopolistic competition and duopolistic competition (Only concept) - Profit maximization -Profit function - Carnot solution to monopoly problem for maximization problem – Joint monopoly and discriminating monopoly - Problems related to profit maximization under monopoly. Duopoly - Conjectural variation and reaction curves - Simple maximization problem under duopoly.	15
V	Theoretical Production functions - Mathematical definition of production function – Constant product curves (Isoquant) - Average and marginal productivity - Homogenous production functions - Properties of linearly homogeneous production function – Cobb-Douglas production function - C. E. S. production function	15
	Total	**75**
	Theory 80% Problem 20%	

CO	Course Outcomes The Students will be able to
CO1	Calculate and interpret price and income elasticity of demand, including partial elasticity, and solve simple numerical problems related to demand analysis.
CO2	Analyze the factors affecting supply and explain the interaction between demand and supply in determining market equilibrium.
CO3	Solve numerical problems related to cost analysis and revenue maximization, and apply these concepts to optimize business performance and decision making
CO4	Differentiate among various market structures and explain the behavior of firms under competitive and monopolistic market conditions.
CO5	Explain the theoretical foundations of production functions, isoquants, and average and marginal productivity in production analysis.
Recommended Text books:	
1	B.C Mehta and GMK Madhnani: Mathematics for Economists, Sultan Chand and Company, New Delhi (Chapters 6, 8, and 9). (2019)
2	
Reference Books:	
1	D.Bose An Introduction to Mathematical Economics-Himalaya Publishing House
2	Caral P Simon and Lawrence E.Blume : Mathematics for Economists,Published by w.w.Norton and company2010
3	Chiang,A.C.Fundamentals Methods of Mathematical Economics,McGraw-Hill,1984
Website and e-Learning Sources	
1	http://14.139.185.6/website/SDE/sde173.pdf
2	https://www.vedantu.com/commerce/types-of-market-structures

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	3	3	3	3	2	2
CO2	3	3	3	3	2	3	3	2	2	3	3
CO3	3	2	3	3	3	3	3	3	3	2	2
CO4	3	3	3	3	2	3	3	2	2	3	3
CO5	3	2	3	3	3	3	3	3	3	2	2
Total	15	12	15	15	13	15	15	13	13	12	12
Average	3	2.4	3	3	2.6	3	3	2.6	2.6	2.4	2.4

S-Strong-3 M-Medium-2 L –Low

III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTIN51	**Internship**		**0**	**0**	**0**	**0**	**2**	**0**	**25**	**75**	**100**

	Learning Objectives
LO1	To gain practical exposure by working in a professional environment and understanding real-world applications of theoretical knowledge.
LO2	To identify, analyze, and execute a suitable project related to the field of study during the internship period.
LO3	To develop technical, problem-solving, and teamwork skills through active participation in assigned tasks.
LO4	To enhance documentation and reporting skills by preparing a structured internship report as per institutional guidelines.
LO5	To improve communication, presentation, and interpersonal skills through interaction and viva voce evaluation.

	REGULATIONS	
1	All students are required to complete an internship in a relevant company, industry, or organization as part of their course to gain practical experience.	
2	After finishing the fourth semester, students must select and evaluate an appropriate project to be carried out during the second-year vacation for duration of 30 hours.	
3	Throughout the internship, students should actively engage in the tasks assigned to them and maintain proper records of the work completed during the training period.	
4	Students must prepare a comprehensive internship report and submit it in the format specified by the institution.	
5	The internship report must be submitted at the end of the semester, followed by a viva voce examination**,** which is compulsory. Failure to submit the report or attend the viva will result in the student being marked **absent.**	
6	The internship will be evaluated for a total of 100 marks**,** comprising Internal Assessment – 25 marks and External Examination – 75 marks**,** including evaluation of the report and viva voce. The assessment will be conducted jointly by internal and external examiners as per university norms.	
7	Students must obtain at least 50% of the total marks to pass. Those who do not achieve this minimum must enhance their performance and resubmit the report in the next attempt. The final report should contain all required sections and be submitted to the Controller of Examinations within the given deadline.	

CO	Course Outcomes
CO1	Apply theoretical knowledge in practical situations through internship experience in a relevant organization.
CO2	Demonstrate the ability to plan, analyze, and complete a project within the given duration effectively.
CO3	Exhibit improved technical competence, problem-solving ability, and teamwork during the training period.
CO4	Prepare and present a detailed internship report following the prescribed academic standards.
CO5	Achieve overall professional development, including communication skills and the ability to perform in viva voce examinations.

Internal Marks Awarded for the Internship–25 Marks

Component	Marks
Internship Review I (During the Beginning of The Semester)	5Marks
Internship Review II (During the End of The Semester)	15Marks
Progress of The Internship by the Student Participated	5Marks

External Marks Awarded for the Internship–75 Marks

Component	Marks
Evaluation of the Internship Report	25Marks
Presentation	25Marks
Viva Voce Examination	25Marks

III YEAR: FIFTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAIK51	**Indian Mathematics: Tradition to Transformation**	**IKS**	**1**	**1**	**0**	**0**	**0**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the origin and development of ancient Indian mathematics and its key contributions.
LO2	To study large numbers, the decimal system and the concepts of zero and infinity in Jain and Buddhist traditions.
LO3	To explore the Bakhshali Manuscript and understand early Indian mathematical notations, operations and the development of Siddhanta astronomy.
LO4	To study the contributions of Aryabhata and his followers in the advancement of Indian mathematics and astronomy.
LO5	To study Western mathematics, European accounts of Indian science and contributions of Srinivasa Ramanujan.

Unit	**Content**	**Hours**
1	**Indian mathematics in world mathematics: An overview** Indian Mathematics: Unravelling its Roots-Indian Mathematics in World Mathematics: Global Interactions **Chapter 2: Section 2.1 to 2.2**	6
2	**From Zero to Infinity: Mathematics in Jain and Buddhist Literature**: Introduction-Large Numbers: An Indian Obsession- The Evolution of the Indian Decimal Place value system-Sunyata and the Emergence of the Mathematical Zero-The Infinity: The Jain Preoccupation **Chapter 4**: **Section4.1 to 4.5**	6
3	**Down to Earth and Reach for the Stars: The Bakhshali and Siddhanta Episodes**: The Bakhshali Manuscript- Notations and Operations-Early Indian Astronomy and the Emergence of the Siddhantas **Chapter 5: Secion 5.1 to 5.3**	6
4	**Heralding the Golden Age: Aryabhata I and his Followers**: Introduction-The Mathematics in Aryabhatiya **Chapter 6: Section 6.1 to 6.2**	6
5	**Battle for the Mind: The Rise of Western Mathematics**: Introduction - Early European Accounts of Indian Astronomy and mathematics-Srinivasa Ramanujan -The Indian Way of Knowing **Chapter13: Section 13.1 to 13.4**	6
	Total	30

Theory 100%

CO	Course Outcomes The students will be able to
CO1	Understand the historical development of ancient Indian mathematics and its major contributions.
CO2	Explain large numbers, the decimal system, zero and infinity in Jain and Buddhist literature.
CO3	Understand the Bakhshali Manuscript and the development of early Indian mathematical methods and Siddhanta astronomy.
CO4	Describe the contributions of Aryabhata and his followers in the development of Indian mathematics and astronomy.
CO5	Describe Western mathematics, European accounts of Indian scienceand contributions of Srinivasa Ramanujan.
Recommended Text Book:	
1	George Gheverghese Joseph, Indian Mathematics Engaging with the World from Ancient to Modern Times, World Scientific Publishing Co. Pvt. Ltd, First Indian Edition, 2022. Reprinted, 2024.
Reference Books:	
1	Kaye, G.R The Bakhshalt Manuscript: A Study in Mediaeval Mathematics, Archaeological Survey of India, New Imperial Series, Vol. 43. Parts 1-3. Government of India Central Publication Branch, 1933.
2	Keller, A. Expounding the Mathematical Seed. Vols. 1 and 2, Birkhauser, Basel-2006.
3	Puttusaamy, T. Mathematical Achievements of Pre-modern Indian Mathematicians, Elsevier, London-2012.
4	Shukla, K. S. Aryabhatiya of Aryabhata, with the Commentary of Bhaskara I and Somesvara, Indian National Science Academy, New Delhi-1976.
5	Sihag, B. S. Koutilya: The True Founder of Economics, Vitasta Publications, New Delhi-2014
Website and e-Learning Sources	
1	https://mathshistory.st-andrews.ac.uk/HistTopics/Jaina_mathematics/
2	https://indicmandala.com/ancient-jaina-mathematics/

Mapping with Programme Outcomesa nd Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	3	2	3	3	3
CO2	2	3	2	3	3	3	3	2	2	3	2
CO3	3	2	2	3	3	3	3	2	3	3	2
CO4	3	3	3	3	3	2	2	2	3	3	3
CO5	3	2	3	3	3	3	2	2	3	3	3
Total	14	12	13	14	15	13	13	10	14	15	13
Average	2.8	2.4	2.6	2.8	3	2.6	2.6	2	2.8	3	2.6

3–Strong, 2-Medium, 1-Low

III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC61	**Testing of Statistical Hypothesis**	**Core**	**3**	**1**	**1**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the fundamental concepts of statistical hypothesis.
LO2	To learn the concept of the Likelihood Ratio Test (LRT)**,** parameter space, and the theoretical properties of the likelihood ratio test in statistical inference.
LO3	To apply Tests of Significance for single proportion, difference of proportions, single mean, and difference of standard deviations.
LO4	To understand the application of small-sample tests such as the Student's t-test, F-test, and Chi-square test in statistical inference.
LO5	To analyze the basic concepts and importance of non-parametric tests and their applications when the population distribution is unknown

Unit	**Content**	**Hours**
I	**Testing of Hypothesis:** Introduction - Statistical Hypothesis - Simple and composite hypothesis, Null and Alternative Hypothesis - Two types of errors - critical region. Level of significance - powers of the test – Most powerful test(MP Test)- Uniformly most powerful tests (UMP Test)- Neyman-Pearson lemma. Simple Problems	15
II	**Likelihood Ratio Test**: Parameter Space-Properties of Likelihood Ratio Test-Test for the mean of a Normal Population-Test for the variance of a Normal Population	15
III	**Tests of significance Large sample**: Sampling of Attributes-Test of significance for single proportion- Test of significance for difference proportion. Sampling of Variables- Test of significance for single Mean- Test of significance for difference mean- Test of significance for the difference standard deviation. Simple problems	15
IV	**Tests of significance small sample**: t test for single mean- t test for difference mean-Paired t test for difference mean-F test for equality of two population variances-Chi square test population variance-Test of independence of Attributes. Simple problems	15
V	**Non-parametric tests** : Wald- Wolfowitz Run test- Median test-, Sign test - Mann Whitney Wilcoxon test.-Simple problems	15
	Total	**75**

Theory 80% Problem 20%

CO	Course Outcomes **The students will be able to**
CO1	Apply and differentiate statistical hypotheses and testing procedures**.**
CO2	Explain the likelihood ratio test framework**, i**ncluding parameter space and important properties of the likelihood ratio test.
CO3	Perform hypothesis testing for large samples, including tests for proportions and means, and interpret the results accurately.
CO4	Analyze small-sample data using Student's t-test, F-test, and Chi-square test to draw inferences
CO5	Interpret the principles and procedures of non-parametric tests and identify situations where they are appropriate.
Recommended Text book:	
1	Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2014.
Reference Books:	
1	Hogg R.V. and Craig, A.T.: Introduction to mathematical statistics, 3rd edition, Academic Press, USA, 1972.
2	Marek Fisz: Probability theory and Mathematical statistics, John Wiley, 1961.
3	Goon, A.M. Gupta, M.K., and Das Gupta, B.: An outline of statistical theory, Volume -I, 6th revised ed. World Press limited, Calcutta , 1980.
Website and e-Learning Source	
1	https://www.gucdoe.in/sites/default/files/COM_1046_B2.pdf
2	https://gacbe.ac.in/pdf/ematerial/18BST62C-U2.pdf
3	https://byjus.com/maths/non-parametric-test/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	3	3	3	3
CO2	3	3	3	3	2	2	3	2	3	2	2
CO3	3	3	3	3	3	3	2	3	3	3	3
CO4	3	2	3	2	3	2	3	2	3	3	2
CO5	3	3	3	2	3	2	2	2	3	3	2
Total	15	14	15	12	14	12	12	12	15	14	12
Average	3	2.8	3	2.4	2.8	2.4	2.4	2.4	3	2.8	2.4

3 – Strong, 2- Medium, 1- Low

III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC62P	**Statistical Practical - VII Using SPSS**	**Core Practical**	**0**	**0**	**5**	**0**	**3**	**5**	**25**	**75**	**100**

Learning Objectives	
LO1	To study the application of the Neyman–Pearson Lemma in constructing the most powerful statistical test.
LO2	To analyze tests of significance for single proportion, difference of proportions, single mean, and difference of means/standard deviations in practical problems.
LO3	To apply the application of paired t-test and F-test for testing the difference of means and equality of variances.
LO4	To study the procedures for Chi-square test for population variance, goodness of fit, and independence of attributes (contingency table)**.**
LO5	To understand the concept and importance of non-parametric statistical tests when population distribution is unknown.

Unit	**Content**	**Hours**
I	**Neyman-Pearson lemma.** Power of the test, level of significance, Type-I and Type-II Error	15
II	**Test of Significance of Large sample** Test of significance for single proportion. Test of significance for difference proportion. Test of significance for single Mean. Test of significance for difference Mean. Test of significance for the difference standard deviation.	15
III	**Tests of significance small sample**. t test for single mean t test for difference mean Paired t test for difference mean F test for equality of two population variances.	15
IV	**Test of significance of χ^2 Test** Chi square test population variance. Chi square test for Goodness of fit. Test of independence of Attributes. (Contingency Table)	15
V	**Non-Parametric Test** Wald- Wolfowitz Run test. Median test. Sign test Mann Whitney Wilcoxon test.	15
	Total	**60**
	Problem 100%	

CO	Course Outcomes The Student will be able to
CO1	Apply the Neyman–Pearson Lemma and compute the power of a statistical test for given practical problems.
CO2	Interpret the results of hypothesis tests and make statistical decisions based on the level of significance**.**
CO3	Apply t-tests and F-test to test equality of two means, two population variance**s** and interpret the results in hypothesis testing.
CO4	Analyze the Chi-square test of independence using contingency tables and interpret the results.
CO5	Analyze non-parametric tests like the run test, median test, and sign test to analyze sample data.
Recommended Text Books:	
1	Gupta S.C. and Kapoor V.K : Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi , 2007.
2	Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons , 2014.
Reference Book:	
1	Hogg R.V. and Craig, A.T. Introduction to mathematical statistics, 3rd edition, Academic Press, USA. 1972

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	3	3	3	3
CO2	3	3	3	2	2	2	2	2	3	2	2
CO3	3	3	3	2	3	3	2	3	3	3	3
CO4	3	3	3	2	3	2	2	2	3	3	2
CO5	3	3	2	2	3	2	2	2	2	3	3
Total	15	15	14	10	14	12	10	12	14	14	13
Average	3	3	2.8	2	2.8	2.4	2	2.4	2.8	2.8	2.6

3 – Strong, 2- Medium, 1- Low

III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTC63P	Project	Core	0	0	0	5	4	25	25	75	100

	Learning Objectives
LO1	To Engage in a real-time project environment to apply theoretical knowledge for practical problem-solving.
LO2	To Analyze different stages of project development and implementation while demonstrating effective teamwork and collaboration.
LO3	To Demonstrate technical proficiency, analytical skills, and professional ethics in executing the assigned project work.
LO4	To Develop specialized knowledge and innovative approaches relevant to the chosen project domain.
LO5	To Strengthen communication, documentation, and presentation skills required for professional project execution.

	REGULATIONS	
1	Every student must undertake a project work in a relevant domain, preferably aligned with their area of specialization, during the course of study to gain practical and analytical exposure.	
2	Each student shall undertake the project work either individually or in a group under the guidance of a faculty member, ensuring proper supervision throughout the project.	
3	During the project period, students shall actively engage in all phases of the work, including problem identification, analysis, design, implementation, and documentation.	
4	A comprehensive project report shall be prepared and submitted by the student in accordance with the prescribed institutional format.The Project Report shall be prepared using Times New Roman font, size 12, with double line spacing, and the total length of the report shall be between 60 and 100 pages, including annexures.	
5	The project report submission will take place at the end of the semester, followed by a presentation and viva voce evaluation during the semester examination.	
6	The project work shall be evaluated for a total of 100 marks, comprising Internal Assessment of 25 marks and External Examination of 75 marks. The Internal Assessment includes 15 marks for the project report and 10 marks for the Internal Viva-Voce. The External Examination includes 50 marks for the project report and 25 marks for the Viva-Voce.	
7	Students must secure at least 50% of the total marks to pass. Those who fail to meet this requirement must improve their performance and resubmit the project report in the next available attempt. The final report must include all prescribed sections and be submitted to the Controller of Examinations within the specified date.	

CO	Course Outcomes
CO1	Identify and define a real-world problem, applying relevant concepts and methodologies to develop an effective project solution.
CO2	Cultivate independent thinking, critical analysis, and collaborative skills throughout the project lifecycle.
CO3	Demonstrate professional ethics, responsibility, and effective project management abilities.
CO4	Communicate technical findings clearly through well-structured documentation and presentations.
CO5	Enhance readiness for professional employment or further research by applying innovative and creative approaches to project development.

Internal Marks Awarded for the Project - 25 Marks

Component	Marks
Project Review I (Beginning of the Semester)	5 Marks
Project Review II (End of the Semester)	15 Marks
Active Participation and Progress of the Project	5 Marks

External Marks Awarded for the Project – 75 Marks

Component	Marks
Evaluation of the Project Report	25 Marks
Project Presentation	25 Marks
Viva Voce Examination	25 Marks

III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTE61	Stochastic Processes	Elective	3	1	1	0	4	5	25	75	100

Learning Objectives

LO1	To understand the fundamentals of stochastic processes with emphasis on Markov chains
LO2	To introduce the fundamentals of Markov Chains and analyze their transition behavior over time
LO3	To provide Markov Processes with discrete state space, including the formulation and properties of the Poisson Process
LO4	To study fundamentals of Continuous-Time Markov Chain and analyze state transitions over continuous time.
LO5	To apply models such as M/M/1 Queue and M/M/s Queue under finite and infinite capacity conditions.

Unit	Content	Hours
I	Introduction and concept of Stochastic Processes -Markov chains: Definition and examples of Markov chain, Transition Probability Matrix, classification of states, recurrence, simple problems	15
II	Markov Chains – Determination of Stability of a Markov System –Limiting Behavior – Ergodic theorem. One dimensional random walk.	15
III	Markov Processes with discrete state space: Poisson Process – Postulates of Poisson process Properties of Poisson Process – Poisson process and related distributions. Pure Birth process – Yule-Furry process. Pure Death Process – Simple Birth and Death Process.	15
IV	Continuous Time Markov chain: Pure birth process and Poisson process, Birth and Death process, problems.	15
V	Applications in Stochastic Models: Queuing Systems and Models: Simple queuing models M/M/1, M/M/s queuing systems (finite and infinite) steady state solution-simple problems with finite and infinite capacities.	15
	Total	**75**

Theory 80% Problem 20%

CO	Course Outcomes **The students can be able to**
CO1	Analyze stochastic systems using Markov chains by constructing transition probability matrices, classifying states, and evaluating recurrence and long-term behavior.
CO2	Determine the stability and long-run (steady-state) behavior of Markov systems and interpret limiting probabilities.
CO3	Apply Poisson processes and related distributions to model random events occurring over time.
CO4	Explain real-world systems using continuous-time Markov chains and related stochastic processes.
CO5	Solve numerical problems involving M/M/1 and M/M/s models with finite and infinite capacities and interpret results in practical contexts.
Recommended Text Book:	
1	Medhi, J.: Stochastic processes, New Age International Private Ltd , (1996).
Reference Books:	
1	Karlin, S. and Taylor, H.M.: A first course in Stochastic processes, Academic Press, (1975).
2	Adke, S.R. and Manjunath, S.M.: An introduction to Finite Markov Processes, Wiley Eastern , (1984).
3	Ross, S.M.: Stochastic processes, John Wiley ,(1983).
Website and e-Learning Sources:	
1	https://www2.math.uu.se/~takis/L/McRw/mcrw.pdf
2	https://www.stat.auckland.ac.nz/~fewster/325/notes/325book.pdf
3	https://www.scribd.com/document/842955024/Lecture-6-and-7-Poisson-process-birth-and-death

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	2	2	2	3
CO2	3	3	2	3	2	3	2	3	3	3	2
CO3	2	3	3	3	3	2	2	3	3	3	2
CO4	3	2	2	3	3	3	3	3	3	3	3
CO5	3	3	2	3	3	3	2	3	3	3	2
Total	14	14	11	15	13	14	11	14	14	14	12
Average	2.8	2.8	2.2	3	2.6	2.6	2.2	2.8	2.8	2.8	2.4

3 – Strong, 2- Medium, 1- Low

III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTE62	**Indian Official Statistics**	**Elective**	**3**	**1**	**1**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives	
LO1	To understanding the functioning of statistical organization in India
LO2	To familiarize students with the concept, methods, and significance of official statistics and their role in economic and social planning.
LO3	To study basic fundamentals of agricultural and industrial statistics
LO4	To develop practical skills in constructing and interpreting different index numbers
LO5	To develop knowledge of wage, trade, and financial statistics and their applications in analyzing the performance of various sectors of the Indian economy

Unit	Content	Hours
I	Statistical System in India: Central and State Government Organizations, Functions of Central Statistical Organization (CSO), National Sample Survey Organization (NSSO) -Sampling fundamentals - sampling and non-sampling errors - large scale sample surveys	15
II	Official statistics: Meaning, methods of collection, limitations and reliability. Principal publications containing data on the topics such as population, agriculture, industry, trade,prices, labour and employment, transport and communications - Banking and finance	15
III	System of Collection of Agricultural Statistics - Crop forecasting and estimation - Productivity, fragmentation of holdings - Support prices - Buffer stocks - Impact of irrigation projects - Industrial statistics	15
IV	Index Numbers - Price, Quantity and Value indices. Price Index Numbers: Construction,Uses, Limitations, Tests for index numbers - Consumer Price Index, Wholesale Price Index and Index of Industrial Production - Construction of index numbers and uses	15
V	National Income - Measures of national income - Income, expenditure and production approaches - Applications in various sectors in India - Wage Statistics - Trade Statistics -Financial Statistics	15
	Total	**75**

Theory 80% Problem 20%

CO	Course Outcomes The students will be able to
CO1	Explain the structure and functions of statistical organizations in India
CO2	Understanding the meaning, methods of collection, limitations, and reliability of official statistics used in policy formulation and research.
CO3	Design the techniques of agricultural and industrial statistics
CO4	Construct and analyze price, quantity, and value indices, including CPI, WPI, and IIP, for interpreting trends in economic and industrial performance.
CO5	Analyze and interpret wage, trade, and financial statistics and evaluate their applications in assessing economic activities in India.
Recommended Text books:	
1	Saluja, M.R (1972): Indian official statistical systems: Statistical publishing society, Calcutta and The Indian Econometric Society, Hyderabad
2	Central Statistical Organisation (1995), Statistical System in India, Ministry of Statistics and Programme Implementation, India
Reference Books:	
1	Goon A. M., Gupta M. K., and Dasgupta. B. (2001), Fundamentals of Statistics, Vol.2, World Press, India.
2	Allen R. G. D. (1975). Index Numbers in Theory and Practice, Macmillan.
Web Resources:	
1	https://en.wikipedia.org/wiki/Central_Statistics_Office_(India)
2	https://vajiramandravi.com/upsc-exam/national-income/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	2	2	2	3
CO2	3	3	2	3	2	3	2	3	3	3	2
CO3	3	3	3	3	3	2	3	3	3	3	2
CO4	3	2	2	3	3	3	3	3	3	3	3
CO5	3	3	2	3	3	2	2	3	3	3	2
Total	15	14	12	15	13	13	13	14	14	14	12
Average	3	2.8	2.4	3	2.6	2.6	2.6	2.8	2.8	2.8	2.4

3 – Strong, 2- Medium, 1- Low

III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTE63	**Actuarial Statistics**	**Elective**	**2**	**1**	**2**	**0**	**4**	**5**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the concepts of Simple Interest and Compound Interest and their applications in financial calculations.
LO2	To study the principles of financial products such as annuities, endowments, assurances, accumulations, and family income benefits.
LO3	To provide knowledge of policy values, including surrender values, paid-up policies, and premium determination in life insurance.
LO4	To explain the concepts of contingent functions, including contingent probabilities, assurances, and decrement tables in actuarial science.
LO5	To develop the ability to compute net premiums for assurance and annuity contracts, including level annual premiums for temporary assurance.

Unit	Content	Hours
I	Simple and compound interest, present value and accumulated values of fixed rate, varying rate of interest	15
II	Mortality: Gompertz - Makeham laws of mortality - life tables. Annuities: Endowments, Annuities, Accumulations, Assurances, Family income benefits.	15
III	Policy Values : Surrender values and paid up policies, industrial assurances, Joint life and last survivorship, premiums.	15
IV	Contingent Functions: Contingent probabilities, assurances. Decrement tables. Pension funds: Capital sums on retirement and death, widow's pensions, benefits dependent on marriage.	15
V	Principles of insurance, pure endowment, whole life assurance, Net premium for assurance and annuity plans-level annual premium under temporary assurance.	15
	Total	**75**

Theory 30% Problem 70%

CO	Course Outcomes The students will be able to
CO1	Compute simple and compound interest, present value, and accumulated value for different financial scenarios.
CO2	Evaluate different types of annuities and insurance-related financial products and apply them to real-life financial planning.
CO3	Analyze and compare different insurance schemes, including industrial assurances, joint life, and last survivorship policies for practical applications
CO4	Analyze and compute contingent probabilities and assurances, and construct and interpret decrement tables.
CO5	Explain insurance principles and evaluate different life insurance products, including pure endowment and whole life assurance.
Recommended Text books:	
1	Hooker, P.F., Longley, L.H.-Cook, Life and other contingencies,Cambridge, 1957.
2	Alistair Neill, Life contingencies, Heinemann professional Publishing, 1977.
Reference Books:	
1	Study material of IAI/IFoA of Actuarial Societies
2	Hosack, I.B., Pollard, J.H. and Zehnwirth, B, introductory statistics with applications in general insurance, Cambridge, 1999
Web Resources:	
1	https://cbseacademic.nic.in/web_material/Manuals/appliedmaths/Chapter11_Basics_Financial_Mathematics.pdf
2	https://www.shriramlife.com/blog/advice/understanding-surrender-value-in-life-insurance
3	https://www.sciencedirect.com/topics/social-sciences/pension-fund

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	2	2	2	3
CO2	3	3	2	3	2	3	2	3	3	3	2
CO3	3	3	3	3	3	2	3	3	3	3	2
CO4	3	2	2	3	3	3	3	3	3	3	3
CO5	3	3	2	3	3	2	2	3	3	3	2
Total	15	14	12	15	13	13	13	14	14	14	12
Average	3	2.8	2.4	3	2.6	2.6	2.6	2.8	2.8	2.8	2.4

3 – Strong, 2- Medium, 1- Low

III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24USTE64	Financial Analytics	Elective	2	1	2	0	4	5	25	75	100

Learning Objectives	
LO1	To classify the fundamentals of financial analytics and its role in modern finance.
LO2	To construct the structure, functions, and regulatory framework of the stock market.
LO3	To apply portfolio management principles, including asset allocation and investment analysis techniques.
LO4	To analyze financial risks and apply appropriate risk assessment and management methods.
LO5	To understand fraud analytics and develop strategies for fraud detection and prevention.

Unit	Content	Hours
1	**Understanding Financial Analytics:** Provide an in-depth understanding of financial analytics - its relevance, and scope in today's financial landscape - Highlight recent trends and introduce the tools and techniques employed in finance.	15
2	**Stock Market Fundamentals:** Introduce the history – importance and role of the stock market in the economy. Familiarize students with stocks - bonds, derivatives, and the roles of different market participants - Long-term vs. short-term investing - Diversification and its importance in a portfolio Regulatory bodies and their role in overseeing stock market activities - Compliance and legal aspects in stock market operations.	15
3	**Portfolio Management Skills:** The principles of portfolio construction - including Modern Portfolio Theory, asset allocation, and the use of fundamental and technical analysis. Explore behavioral finance - the Capital Asset Pricing Model - risk measures in portfolio management.	15
4	**Risk Assessment and Management:** Explain different types of financial risks - their characteristics, and interrelationships. Cover methodologies such as Value at Risk - stress testing, and risk control methods like hedging and diversification. Discuss regulatory aspects related to risk management.	15
5	**Fraud Analytics and Prevention:** Define various types of financial fraud, emphasize ethical considerations - regulatory compliance - the strategies and technologies employed in fraud risk management. Introduce real-world case studies for practical understanding.	15
	Total	**75**

Theory 80% problem 20%

CO	Course Outcomes The Students will be able to
CO1	Understand the significance and relevance of financial analytics, recent trends and the application of analytical tools and techniques in finance.
CO2	Gain a comprehensive understanding of the stock market, its history, functions and the roles played by different market participants and regulatory bodies.
CO3	Acquire the skills necessary to construct portfolios based on Modern Portfolio Theory, analyze asset allocation, employ fundamental and technical analysis and monitor and adjust portfolios.
CO4	Identify different types of financial risks, understand risk and return relationships and apply various risk assessment and management techniques.
CO5	Recognize different types of financial fraud apply ethical considerations in fraud detection and develop strategies to prevent and manage fraud.
Recommended Text book:	
1	Pitabas Mohanty, Financial Analytics, Wiley India, ISBN 978-93-5464-417-7, 2023.
Reference Books:	
1	Argimiro Arratia, Computational Finance An Introductory Course with R, Atlantis Press, ISBN 978-94-6239- 069-0, 2014.
2	Bernhard Pfaff, Financial risk Modeling and portfolio optimization with R, Wiley, ISBN 978-0-470-97870-2, 2013.
3	Cairns, A.J. G, and Interest Rate Models: An Introduction, Princeton University Press, ISBN: 9780691118949, 2004.
4	Christian Gourieroux & Joann Jasiak, Financial Econometrics: Problems, Models, and Methods, Princeton University Press, ISBN: 9780691088723, 2002.
5	David Ruppert, Statistics and Data Analysis for Financial Engineering, Springer, ISBN 978-1-4419-7786-1, 2011.
Website and e-Learning Sources:	
1	https://nptel.ac.in/
2	https://www.sanctions.io/blog/financial-fraud-prevention

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	3	2	2	3	3
CO2	2	3	3	2	2	3	2	3	2	3	3
CO3	3	2	2	2	3	2	3	3	2	2	3
CO4	2	3	2	2	2	3	3	2	2	2	2
CO5	3	2	2	2	2	3	2	3	3	3	2
Total	13	12	11	10	11	13	13	13	11	13	13
Average	2.6	2.4	2.2	2	2.2	2.6	2.6	2.6	2.2	2.6	2.6

3 – Strong, 2- Medium, 1- Low

III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAP61	**Data Visualization Using TABLEAU**	**PEC**	**1**	**1**	**1**	**0**	**2**	**3**	**25**	**75**	**100**

Learning Objectives	
LO1	To understand the Tableau analytics platform, workspace and data preparation.
LO2	To create basic data visualizations including bar, line and heat maps.
LO3	To apply advanced visualization techniques using calculated fields, parameters and aggregation.
LO4	To design symbol maps, filled maps, density maps and maps with pie charts.
LO5	To build interactive dashboards, apply dashboard actions and visualize cloud data.

Unit	Content	Hours
1	**Introduction to Tableau:** Data types - Data collection - Setting up a Data Connector - Selecting Data Tables – Joins – Unions - Data extracts and live connections - Editing the model's metadata.	9
2	**Creating Basic Data Visualizations:** Creating Charts - Chart types -Bar Charts, Legends, Filters and Hierarchies - Line Charts - Highlight Tables - Heat Maps - Bullet Charts - Cumulative Sums with Waterfall Charts.	9
3	**Creating Advanced Data Visualizations:** Aggregate Functions - Calculated Fields - Aggregations in Calculated Fields - Text Operator - Data fields - Logical functions – Parameters - Types of calculations - Quick Table calculations - Level of detailed expression.	9
4	**Creating Symbol Maps:** Filled Maps - Density Maps - Map Layers - Maps embedded with Pie Charts.	9
5	**Creating Interactive Dashboards:** Creating Dashboard - Dashboard Title - Navigation Buttons - Dashboard Actions - Templates for visualizing Cloud data.	9
	Total	45
	Theory 100%	

CO	Course Outcomes The Student will be able to
CO1	Explain the Tableau environment, data connections and data preparation techniques.
CO2	Create basic visualizations such as bar charts, line charts and heat maps.
CO3	Apply calculated fields, aggregate functions and parameters for advanced visualizations.
CO4	Design geographic visualizations using symbol maps, filled maps and density maps.
CO5	Develop interactive dashboards with filters, actions and navigation features.
Recommended Text Book:	
1	Claus O. Wilke, Fundamentals of Data Visualization, O'Reilly, 2019.
Reference Books:	
1	Alexander Loth, Visual Analytics with Tableau, Wiley, 2019.
2	Davy Cielen, Arno D. B. Meysman and Mohamed Ali, Introducing Data Science, Manning Publications, 2016.
3	D J Patil, Hilary Mason & Mike Loukides, Ethics and Data Science, O' Reilly, 2018.
Website and e-Learning Sources:	
1	https://www.geeksforgeeks.org/tableau/tableau-tutorial/
2	https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/data-visualization-with-r/?v=13b5bfe96f3e
3	https://www.javatpoint.com/tableau

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	2	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	2	3	3	3	3	3	2	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	14	15	15	14	15	14	14	15	15	14	15
Average	2.8	3	3	2.8	3	2.8	2.8	3	3	2.8	3

3 – Strong, 2- Medium, 1- Low

III YEAR: SIXTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24UMAL61	**Mathematical Aptitude**	**SLC**	**0**	**0**	**0**	**2**	**2**	**2**	**25**	**75**	**100**

Learning Objectives	
LO1	To build skills in simplifying surds and indices, applying profit and loss concepts, and solving problems using ratio and proportion.
LO2	To apply partnership and chain rule to solve profit-sharing and time-work problems.
LO3	To solve problems on boats and streams and mixtures using the allegation method.
LO4	To develop the ability to solve verbal reasoning problems on coding–decoding and blood relations with logical accuracy and clear interpretation.
LO5	To enhance non-verbal reasoning skills by solving analogy and classification problems with logical accuracy and pattern recognition.

Unit	Content	Hours
1	**Arithmetical Ability** Surds and Indices-Profit and Loss-Ratio and Proportion Chapter: 9, 11-12	6
2	**Arithmetical Ability (Contd..)** Partnership - Chain Rule. Chapter: 13-14	6
3	**Arithmetical Ability (Contd..)** Boats and Streams - Alligation or Mixture Chapter: 19-20	6
4	**Verbal Reasoning** Coding- Decoding-Blood Relations Chapter: 4-5	6
5	**Non-Verbal Reasoning** Analogy-Classification **Chapter :2-3**	6
	Total	30

Problems 100%

CO	Course Outcomes The Students will be able to
CO1	Simplify surds and indices, solve profit and loss problems and apply ratio–proportion reasoning in practical contexts.
CO2	Apply partnership and chain rule concepts to solve problems involving profit-sharing and proportional work.
CO3	Apply boats and streams concepts and the alligation method to accurately solve practical problems involving speed, distance, and mixtures.
CO4	Accurately solve verbal reasoning problems on coding–decoding and blood relations by applying logical interpretation and analytical skills.
CO5	Solve non-verbal reasoning problems involving analogy and classification using logical reasoning.

Recommended Text:	
1	Dr. R.S. Aggarwal, Quantitative Aptitude , S.Chand& Company, New Delhi (Unit 1,2,3)
2	Dr. R.S. Aggarwal, A Modern Approach to Verbal and Non-Verbal Reasoning, S.Chand & Company, New Delhi (Unit 4,5)
Reference Books:	
1	Praveen R.V, Quantitative Aptitude and reasoning, PHIL earning Pvt, New Delhi
2	Abhijit Guha-Quantitative Aptitude for Competitive Examinations-6th Edition-Mc Graw Hill Education Pvt Ltd, Chennai
3	U. Mohan Rao-Quantitative Aptitude for Competitive Examinations-Scitech Publications Pvt Ltd, Chennai.
4	Arun Sharma-Teach Yourself Quantitative Aptitude- Mc Graw Hill Education Pvt Ltd, Chennai-second Edition
5	Rapid Quantitative Aptitude-Er.Deepak Agarwal, Mr. D. P. Gupta – Disha Nursuring Ambitions
Website and e-Learning Source	
1	https://guides.lib.uni.edu/oer

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	3	3	3	2	3
CO2	3	3	2	3	3	3	3	2	2	3	2
CO3	2	2	2	3	2	3	3	3	3	2	2
CO4	3	3	3	2	3	2	2	2	3	3	3
CO5	3	3	3	3	3	3	2	3	3	2	3
Total	14	13	13	13	14	13	13	13	14	12	13
Average	2.8	2.6	2.6	2.6	2.8	2.6	2.6	2.6	2.8	2.4	2.6

3–Strong, 2-Medium, 1-Low