DEPARTMENT OF STATISTICS

M.Sc. Statistics (A.Y. 2024-2025)

VISION:

The department of Statistics aspires to establish and develop a nucleus of academic eminence and calibre in mathematical and applied Statistics through dynamic teaching, learning and collaborative research work thereby bringing out the best statisticians.

MISSION:

The mission of our department includes the following:

Mission 1: Advancing Statistical Knowledge: Conduct cutting-edge research to develop new statistical methodologies and improve existing techniques, contributing to the field's theoretical and practical advancements.

Mission 2: Providing High-Quality Education: Offer comprehensive undergraduate and graduate programs to train students in statistical theory, methods, and applications, preparing them for careers in academics, industry and government sectors.

Mission 3: Promoting Interdisciplinary Collaboration: Foster partnerships with other academic departments, research institutions, and industry to apply statistical methods to a wide range of disciplines, enhancing the impact and relevance of statistical science.

Mission 4: Engaging in Community Outreach: Serve the broader community by providing statistical consulting services, organizing workshops and seminars, and promoting statistical literacy among the public.

PROGRAMME EDUCATIONAL OBJECTIVES:

PEO1: Academic and Professional Excellence

Graduates will possess advanced theoretical and applied knowledge in statistics and mathematics, enabling them to pursue successful careers in academia, research organizations, industry and government sectors.

PEO2: Analytical and Technical Proficiency

Graduates will develop strong analytical and computational skills through the use of modern statistical tools, programming languages and data analysis techniques to address complex real-world problems effectively.

PEO3: Research Orientation, Ethics and Lifelong Learning

Graduates will engage in research and innovation with professional ethics, effective communication and a commitment to continuous learning to adapt to emerging technologies and global challenges in the statistical domain.

PROGRAM SPECIFIC OUTCOME (PSOs):

PSO1: Advanced Statistical Knowledge and Analytical Skills

Demonstrate an in-depth understanding of statistical theories, probability models and inferential techniques to analyze and interpret complex real-world data effectively.

PSO2: Application of Statistical Methods and Computational Tools

Apply advanced statistical methodologies, experimental designs and computational tools such as R, Python, and SPSS to model, simulate and solve contemporary problems in science, industry and research.

PSO3: Research Aptitude, Ethics, and Professional Development

Develop research-oriented thinking, ethical responsibility, communication skills and adaptability to pursue lifelong learning and professional careers in academia, data analytics, government and private sectors.

PROGRAMME OUTCOMES:

PO1: Statistical Literacy
Define the fundamental concepts, theories and principles of statistics and mathematics essential for understanding complex statistical problems.

PO2: Conceptual Understanding
Interpret statistical data, graphs and research findings to gain meaningful insights and develop conceptual clarity of real-world applications.

PO3: Practical Application
Apply appropriate statistical methods, models and computational tools to solve real-life problems in various disciplines.

PO4: Analytical Thinking
Analyze datasets and research questions by breaking them into components, identifying patterns and drawing logical inferences.

PO5: Critical Evaluation
Evaluate statistical techniques, models and research designs for accuracy, reliability and ethical appropriateness in data analysis.

PO6: Innovative Modelling
Design innovative statistical models, frameworks or data-driven systems to address emerging challenges in science, business and society.

PO7: Ethical and Social Responsibility
Assess the ethical, societal and environmental implications of statistical practices and promote responsible data usage for sustainable development.

PO8: Collaborative Competence
Develop teamwork, communication and leadership skills to function effectively in multidisciplinary and collaborative environments.

Credit Definition

Type	Duration (in hours)	Credit
Lecture (L)	1	1
Tutorial (T)	1	1
Practical (P)	2	1

Total Credit Distribution for the Entire Programme:

Semester	Credits					Credits/Semester
	CC	DSE	GE	SEC	USC	
1	20	4	0	1	2	27
2	20	4	4	1	2	31
3	21	0	0	1	2	24
4	15	0	0	1	2	18
Credits/Course	**76**	**8**	**4**	**4**	**8**	**100**

Category Definition:

Definition of Category/Type	Abbreviation
Core Courses	**CC**
Discipline Specific Elective	**DSE**
Generic Elective	**GE**
Skill Enhancement Courses	**SEC**
University Specific Courses	**USC**

FIRST YEAR

SEMESTER-I

Sl. No	Course Title	Code	Type	Credit	Type		
					L	T	P
1	Analysis I	STATP001T01	CC	4	3	1	0
2	Measure Theory and Probability	STATP001T02	CC	4	3	1	0
3	Statistical Inference – I	STATP001T03	CC	4	3	1	0
4	Linear Models	STATP001T04	CC	4	3	1	0
5	Statistics Practical – I	STATP001P05	CC	4	0	0	8

6	R Programming	STATP002T06	DSE	4	3	1	0
7	Mentored Seminar – I	MVMSP005S01	SEC	1	0	0	2
8	Foreign Language – I		USC	2	2	0	0
Total Credits				27 Credits			

SEMESTER-II

Sl. No	Course Title	Code	Type	Credit	Type		
					L	T	P
1	Sample Survey and Demography	STATP101T01	CC	4	3	1	0
2	Design of Experiments	STATP101T02	CC	4	3	1	0
3	Statistical Inference – II	STATP101T03	CC	4	3	1	0
4	Regression Analysis	STATP101T04	CC	4	3	1	0
5	Statistics Practical – II	STATP101P05	CC	4	0	0	8
6	Operations Research	STATP102T06	DSE	4	3	1	0
7	Mentored Seminar – II	MVMSP105S02	SEC	1	0	0	2
8	Foreign Language – II		USC	2	2	0	0
9	Generic Elective		GE	4	4	0	0
Total Credits				31 Credits			

SECOND YEAR

SEMESTER-III

Sl. No	Course Title	Code	Type	Credit	Type		
					L	T	P
1	Discrete Data Analysis	STATP201T01	CC	4	3	1	0
2	Time Series Analysis and Stochastic Process	STATP201T02	CC	4	3	1	0
3	Statistical Computing Using Python	STATP201T03	CC	4	3	1	0
4	Master Project	STATP201R04	CC	6	0	0	12
5	Statistics Practical – III	STATP201P05	CC	3	0	0	6
6	Mentored Seminar – III	MVMSP205S03	SEC	1	0	0	2
7	Foreign Language – III		USC	2	2	0	0
Total Credits				24 Credits			

SEMESTER-IV

Sl. No	Course Title	Code	Type	Credit	Type		
					L	T	P
1	Multivariate Analysis	STATP301T01	CC	4	3	1	0
2	Statistical Quality Management and Reliability	STATP301T02	CC	4	3	1	0

3	Biostatistics	STATP301T03	CC	4	3	1	0
4	Statistics Practical – IV	STATP301P04	CC	3	0	0	6
5	Mentored Seminar – IV	MVMSP305S04	SEC	1	0	0	2
6	Foreign Language – IV		USC	2	2	0	0
Total Credits				21 Credits			

COURSE CO-PO-PSO MAPPING

SEMESTER-I

CC1 – Analysis I

COURSE OUTCOMES:

CO1: Explain key concepts in metric spaces.
CO2: Analyze inverse/implicit function using Mean Value Theorem and Chain Rule.
CO3: Examine the properties of functions of bounded variation and absolute continuity.
CO4: Verify the convergence and summability of trigonometric Fourier series using Cesàro methods and inner product techniques in Hilbert spaces.
CO5: Construct the solutions to problems of point-set topology, real-valued function spaces, and approximation theorems.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	-	1	1	1	1	2
CO2	2	1	1	1	1	-	1	1	1	1	2
CO3	2	1	1	1	1	-	1	1	1	1	2
CO4	2	1	1	1	1	-	1	1	1	1	2
CO5	2	1	1	1	1	-	1	1	1	1	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC2 – Measure Theory and Probability

COURSE OUTCOMES:

CO1: **Identify** different types of functions, sequences, sets, and their properties.
CO2: **Use** π-systems and λ-systems to generate sigma-fields and measurable spaces relevant to probability theory.
CO3: **Differentiate** between various types of measures and examine their applicability to probability distributions and measurable functions.

CO4: **Judge** the appropriateness of different convergence theorems in the integration of sequences of random variables.
CO5: **Compose** probability models using measurable functions, Lebesgue integration and expectation to solve real-world problems in measure-theoretic probability.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	2	1	2
CO2	2	1	1	2	1	1	1	1	2	1	2
CO3	2	1	1	2	1	1	1	1	2	1	2
CO4	2	1	1	2	1	1	1	1	2	1	2
CO5	2	1	1	2	1	2	1	1	2	1	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC3 – Statistical Inference - I

COURSE OUTCOMES:

CO1: Illustrate the key concepts of sufficiency, completeness and unbiasedness in the context of point estimation.
CO2: Demonstrate the use of key estimation theorems to obtain minimum variance unbiased estimators within exponential families.
CO3: Differentiate between various hypothesis testing procedures by analyzing criteria such as significance level, power function and p-value.
CO4: Judge the optimality of statistical tests using frameworks like the Neyman-Pearson Lemma, Monotone Likelihood Ratio and UMP/UMPU conditions.
CO5: Design comprehensive inference procedures by integrating concepts of consistency, asymptotic efficiency and likelihood-based methods along with their asymptotic properties.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	1	1	1	3	1	2
CO2	3	1	1	2	1	1	1	1	3	1	2
CO3	3	2	2	2	1	1	1	1	3	2	2
CO4	3	2	2	2	1	1	1	1	3	1	2
CO5	3	1	1	2	1	1	1	1	3	1	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC4 – Linear Models

COURSE OUTCOMES:

CO1: Explain key concepts of linear algebra and statistical inference.
CO2: Implement linear algebra techniques to solve problems involving vector spaces, matrix decompositions, projections and generalized inverses.
CO3: Examine the structure and assumptions of various linear models and explore their relevance in statistical inference.
CO4: Judge the appropriateness of fixed, random and mixed effects models through applications of ANOVA, regression, ANCOVA and multiple comparison techniques in different statistical contexts.
CO5: Design and interpret linear statistical models in real-world contexts using appropriate estimation and hypothesis testing strategies.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	1	2	1	2
CO2	3	2	1	2	1	1	1	1	2	1	2
CO3	3	2	2	2	2	1	1	1	3	2	2
CO4	3	2	2	2	2	2	1	1	3	3	2
CO5	3	2	2	2	2	2	1	1	3	3	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC5 – Statistics Practical - I

COURSE OUTCOMES:

CO1: Explain the ideas of measurable sets and measurable functions to solve problems.
CO2: Solve numerical problems related to point estimation, hypothesis testing and asymptotic inference.
CO3: Outline the knowledge of Gauss-Markov theorem and the theory of linear estimation for solving real-life problems.
CO4: Summarize the knowledge of ANOVA, ANOCOVA and different Regression models to model various real-life datasets and carryout suitable statistical analyses.
CO5: Develop the codes of R programming to solve different statistical problems.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	1	1	-	1	1	2	2	2

CO2	2	3	3	2	2	1	1	1	3	3	2
CO3	2	3	3	1	1	1	1	1	3	3	2
CO4	2	3	3	2	2	2	1	1	3	3	2
CO5	2	3	3	2	2	1	1	1	3	3	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

DSE1 – R Programming

COURSE OUTCOMES:

CO1: **Summarize** key descriptive statistics and visualize data through appropriate graphical representations using R.
CO2: **Execute** correlation, linear regression and logistic regression models in R to analyze relationships between variables**.**
CO3: **Differentiate** between statistical distributions and testing procedures using R by interpreting random samples, fitted models and output summaries**.**
CO4: **Judge** the applicability of different numerical methods implemented in R for solving equations, differentiation and integration in terms of their accuracy and efficiency**.**
CO5: **Design** complete R-based data analysis workflows, integrating data import, statistical modelling and report generation for real-world problems.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	1	1	2	3	3	2
CO2	2	3	3	2	2	1	1	2	3	3	2
CO3	2	3	3	2	2	1	1	2	3	3	2
CO4	2	3	3	2	2	1	1	2	3	3	2
CO5	2	3	3	2	2	1	1	2	3	3	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

SEMESTER-II

CC6 – Sample Survey and Demography

COURSE OUTCOMES:

CO1: Classify and **explain** the fundamental principles of probability sampling and unequal probability designs, including SRS, systematic sampling and inclusion probabilities.
CO2: Apply ratio, product and regression estimators in stratified and multistage sampling to obtain unbiased and efficient population estimates.

CO3: Analyze demographic data to compute mortality, morbidity, fertility and migration measures and interpret life tables for population dynamics.
CO4: **Evaluate** and **compare** different sampling schemes and demographic methods based on precision, bias and suitability for real-world studies.
CO5: Design sampling strategies and develop demographic models for population estimation and projection using advanced statistical frameworks.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	2	2	1
CO2	3	3	3	3	2	2	1	2	2	3	2
CO3	3	3	3	3	3	2	2	2	3	3	2
CO4	2	3	3	3	3	3	2	3	2	2	3
CO5	2	3	3	3	3	3	2	3	2	3	3

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC7 – Design of Experiments

COURSE OUTCOMES:

CO1: Define the concept of design of experiments and its various related terminologies.
CO2: Examine the relative efficiencies of different basic designs.
CO3: Illustrate the concepts of Balanced Incomplete Block Designs (BIBD) and Mutually Orthogonal Latin Squares (MOLS).
CO4: Explain the applications of Row-Column designs and Youden Square design.
CO5: Develop the knowledge of Factorial Experiments, Confounding and Balancing in real life scenarios.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	1	1	2	2	2
CO2	3	2	2	2	2	1	1	1	3	2	2
CO3	3	2	2	2	2	1	1	1	3	2	2
CO4	3	2	2	2	2	1	1	1	3	2	2
CO5	3	2	2	2	2	1	1	1	3	2	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC8 – Statistical Inference - II

COURSE OUTCOMES:

CO1: Describe the basic concepts of one-dimensional and two-dimensional U statistics.
CO2: Visualize problems of non-parametric hypothesis testing in real life scenarios.
CO3: Use non parametric testing methodologies in real-life problems.
CO4: Train with the knowledge of prior and posterior distributions of unknown parameters in Bayesian Statistical Inference.
CO5: Construct various Bayesian Inferential tools to estimate unknown parameters of data.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	3	1	1	1	1	3	1	2
CO2	3	3	3	2	2	1	1	1	3	3	2
CO3	3	2	3	2	2	1	1	1	3	3	2
CO4	3	3	2	3	1	1	1	1	3	2	2
CO5	3	3	3	2	2	1	1	1	3	3	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC9 – Regression Analysis

COURSE OUTCOMES:

CO1: Recall fundamental concepts, transformations (Box-Cox, Box-Tidwell), model validation criteria (R^2, Adjusted R^2, Mallows's Cp, AIC, BIC), residual analysis, and diagnostics including detection of outliers and influential observations.
CO2: Explain the consequences, detection, and remedies of departures from Gauss-Markov assumptions, including heteroscedasticity, multicollinearity, autocorrelation, non-normality, and regression with correlated errors, as well as stepwise regression methodology.
CO3: Apply regression modelling techniques and diagnostic measures to build, validate, and interpret regression models using statistical tools or software.
CO4: Analyse regression models for adequacy, influence of observations, multicollinearity, autocorrelation, and heteroscedasticity, and determine the impact of these factors on inference and prediction.
CO5: Design advanced regression models incorporating appropriate transformations, diagnostic checks, and stepwise selection methods to produce valid, reliable, and interpretable results for real-world data.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1	1	3	2	1
CO2	2	3	3	2	2	1	2	1	3	3	2
CO3	2	2	3	3	2	2	2	1	3	3	2
CO4	1	2	3	3	3	2	1	1	3	3	3
CO5	1	2	3	3	3	3	1	2	3	3	3

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC10 – Statistics Practical - II

COURSE OUTCOMES:

CO1: Select various sample survey methods and vital statistics measures to collect, summarize, and interpret real-life data.
CO2: Construct appropriate Experimental Designs to analyse and compare treatment effects in diverse data-driven studies.
CO3: Identify non-parametric methods and Bayesian computational techniques to solve complex real-world statistical problems.
CO4: Determine regression models to establish relationships between variables and interpret their outcomes effectively.
CO5: Formulate and **develop** solutions using Linear Programming, Queuing Theory, Inventory Control, and Game Theory models for real-life decision-making.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	2	3	2	2
CO2	2	2	3	3	3	2	2	2	3	2	2
CO3	3	3	3	3	2	3	1	2	3	2	2
CO4	3	3	3	3	3	2	1	3	3	2	2
CO5	2	2	3	3	3	3	2	3	3	2	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

DSE2 – Operations Research

COURSE OUTCOMES:

CO1: Explain the fundamental principles, scope, and models of Operations Research, including decision-making under various conditions.
CO2: Apply linear programming, transportation, and assignment techniques to solve optimization and allocation problems in real-life scenarios.
CO3: Analyze game-theoretic models and formulate optimal strategies under competitive and uncertain environments.
CO4: Evaluate different inventory control and queuing models to optimize operational efficiency and resource utilization.
CO5: Design and **develop** integrated optimization models for decision-making, logistics, and production systems using Operations Research principles.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1	1	3	2	1
CO2	3	3	2	2	2	2	1	2	2	3	2
CO3	2	2	3	3	3	2	2	2	3	3	2
CO4	1	2	2	3	2	3	2	2	2	3	3
CO5	2	1	3	2	2	3	2	2	2	3	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

SEMESTER-III

CC11 – Discrete Data Analysis

COURSE OUTCOMES:

CO1*:* Summarize the concepts of retrospective or prospective study designs, contingency tables and polytomous data structures.
CO2*:* Use appropriate association measures and link functions in modelling binary, count and categorical data.
CO3*:* Differentiate between linear and generalized linear models by analyzing components such as link functions and deviance across different types of discrete outcomes**.**
CO4*:* Judge the suitability of logistic, log**-**linear and quasi**-**likelihood models in handling over**-**dispersion and model fit in discrete data analysis**.**
CO5*:* Construct predictive frameworks using association measures, GLMs and zero**-**inflated models to address real**-**world categorical data problems**.**

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	1	1	3	3	2
CO2	3	3	2	2	2	1	1	1	3	3	2
CO3	3	3	2	2	2	2	1	1	3	3	2
CO4	3	3	2	2	2	2	1	1	3	3	2
CO5	3	3	2	2	2	2	1	1	3	3	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC12 – Time Series Analysis and Stochastic Process

COURSE OUTCOMES:

CO1*:* Interpret the basic structure and components of time series data and **explain** common methods for their estimation.
CO2*:* Implement time series models using tools for model identification and estimation.
CO3*:* Differentiate between various smoothing and financial forecasting models by analyzing their assumptions and suitability.
CO4*:* Judge the behaviour of stochastic processes by analyzing their long-term and transitional characteristics.
CO5*:* Construct continuous-time stochastic models to represent dynamic systems like population evolution and resource management.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	1	3	3	2
CO2	3	3	3	3	2	1	1	1	3	3	2
CO3	3	3	3	3	3	2	1	1	3	3	2
CO4	3	3	2	2	2	1	1	1	3	3	2
CO5	3	3	2	2	2	1	1	1	3	3	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC13 – Statistical Computing Using Python

COURSE OUTCOMES:

CO1: Students will be able to **explain** the fundamental concepts of algorithms, flowcharts and Python syntax used for basic problem-solving.
CO2: Students will be able to **apply** various operators, expressions and control structures to develop simple computational programs.
CO3: Students will be able to **analyze** and implement modular programming using functions, recursion, exception handling and object-oriented principles in Python.
CO4: Students will be able to **evaluate** and compare searching and sorting algorithms using appropriate Python data structures.
CO5: Students will be able to **create** efficient Python programs for data handling, cleaning and preprocessing using libraries such as NumPy and Pandas.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	1	1	3	2	1
CO2	3	3	2	2	1	1	1	1	2	3	1
CO3	3	3	2	2	1	1	1	1	2	3	2
CO4	3	3	2	2	1	1	1	1	2	3	2
CO5	3	3	2	2	1	1	1	1	1	3	3

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC15 – Statistics Practical - III

COURSE OUTCOMES:

CO1: Discuss the idea for solving real life problems involving various discrete type data: binary data, count data.
CO2: Explore the idea of different types of generalized linear models to model real life datasets.
CO3: Illustrate the knowledge of different time series models in various aspects of data analysis.
CO4: Explain the knowledge of different stochastic processes and Markov chains to solve various real-life problems.
CO5: Generate codes of Python to solve various statistical problems.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	1	1	1	2	3	2
CO2	2	3	3	2	2	1	1	1	2	3	2
CO3	2	3	3	2	2	1	1	1	2	3	2
CO4	2	3	3	2	2	1	1	1	2	3	2
CO5	2	3	3	2	2	2	1	1	2	3	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

SEMESTER-IV

CC16 – Multivariate Analysis

COURSE OUTCOMES:

CO1: Recall fundamental concepts of multivariate probability distributions, multiple regression, principal component analysis, factor analysis, clustering, and classification methods.
CO2: Explain the properties, assumptions, and applications of multivariate distributions, multiple regression, PCA, factor analysis, clustering algorithms, and discriminant analysis.
CO3: Apply multivariate statistical techniques including multiple regression, PCA, factor analysis, clustering, and discriminant analysis to real or simulated datasets using statistical software.
CO4: Analyze multivariate data, identify patterns, evaluate principal components, factor loadings, clusters, and discriminant functions for decision-making.
CO5: Design multivariate models and clustering/classification schemes for real-world problems integrating PCA, factor analysis, and discriminant analysis for meaningful insights.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1	1	3	2	1
CO2	2	3	3	2	2	1	2	1	3	3	2
CO3	2	2	3	3	2	2	2	1	3	3	2
CO4	1	2	3	3	3	2	1	1	3	3	3
CO5	1	2	3	3	3	3	1	2	3	3	3

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC17 – Statistical Quality Management and Reliability

COURSE OUTCOMES:

CO1*:* Classify the problems of process control and product control.
CO2*:* Apply various control charts to comment on the state of control of a given production process.
CO3*:* Illustrate the concepts of different sampling inspection plans in Product Control.
CO4*:* Compare different types of failure models, design system reliability and **estimate** the parameters in reliability model and construct confidence interval.
CO5*:* Develop the concepts of different types of censoring and regression models in reliability.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	1	1	1	2	2	2
CO2	3	2	2	2	2	1	1	1	3	2	2
CO3	3	2	2	2	2	1	1	1	3	2	2
CO4	3	2	2	2	3	1	1	1	3	3	2
CO5	3	2	2	2	3	1	1	1	3	3	3

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC18 – Biostatistics

COURSE OUTCOMES:

CO1: Study the basic concepts of survival analysis.
CO2: Discuss inferential problems related to survival analysis.
CO3: Use regression models to model and predict survival data.
CO4: Analyze survival data using multivariate models, random effects models.
CO5: Develop the general concepts of clinical trials and its analysis.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	1	1	3	1	2
CO2	3	3	2	3	2	1	1	1	3	3	2
CO3	3	2	2	3	2	1	1	1	3	3	2

CO4	3	3	2	3	2	1	1	1	3	2	2
CO5	3	3	2	3	2	1	1	1	3	3	2

1. LOW 2. MODERATE 3. SUBSTANTIAL

CC19 – Statistics Practical - IV

COURSE OUTCOMES:

CO1: Compute using conceptual understanding of multivariate distributions, including multivariate normal and Wishart distributions, to infer about real-life multivariate data.
CO2: Apply process control and product control techniques to monitor, analyze, and improve industrial processes.
CO3: Illustrate the principles of Reliability theory to solve various related problems.
CO4: Determine appropriate statistical methods for clinical trials to evaluate treatment effectiveness and ensure valid, ethical conclusions.
CO5: Formulate necessary Survival analysis techniques to solve various statistical problems.

MAPPING OF COs WITH POs AND PSOs

COURSE OUTCOMES	PROGRAMME OUTCOMES								PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	1	3	3	2
CO2	3	2	3	3	3	2	1	1	3	3	2
CO3	3	2	3	3	3	3	2	1	3	3	2
CO4	3	3	3	3	3	3	2	2	3	3	2
CO5	3	3	3	3	3	3	2	2	3	3	2

1. LOW 2. MODERATE 3. SUBSTANTIAL
