



DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE
(AUTONOMOUS)
RE-ACCREDITED WITH 'A++' GRADE BY NAAC
College with Potential for Excellence | Linguistic Minority Institution
Affiliated To University of Madras
Arumbakkam, Chennai -106.



DEGREE OF BACHELOR OF SCIENCE
LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK

DEPARTMENT OF STATISTICS (SHIFT-II)



Syllabus for B. Sc., Statistics

**(For Candidates admitted from the Academic Year
2025 – 2026 and Onwards)
UNIVERSITY OF MADRAS**

INSTITUTION

VISION

To impart value-based quality academia; to empower students with wisdom and to charge them with rich Indian traditions and culture; to invoke the self, to broaden the same towards nation building, harmony and Universal brotherhood.

MISSION

To ensure sustained progress and development in imparting quality education, to pioneer new avenues of teaching and research and to emerge as an institution with potential for excellence.

DEPARTMENT OF STATISTICS

VISION

- With fast technological advancements in area like Artificial Intelligent, the job market is looking for candidates with technical and data analytics skills. Our aim is to provide quality education to our students practically and theoretically.
- In the upcoming years, some of the most renowned jobs will be occupied by statisticians.

MISSION

M1	Statistics is to help students to develop their understanding skills
M2	Statistics is to help them problem solving ability.
M3	The subject of statistics Programs to give the logical thinking to the students

PROGRAM EDUCATION OBJECTIVES (PEOs)

PEO1	Students will be able to understand the Application and limitations of statistics.
PEO2	Students have to know the collection and Classification of the data.
PEO3	Students will be able to calculate the needful information.
PEO4	Students have come to know which type of test to apply for the particular problem.
PEO5	Students have to know how to draw the conclusion after the particular test applied.

PEO TO MISSION STATEMENT MAPPING

MISSION STATEMENTS	PEO1	PEO2	PEO3	PEO4	PEO5
M1	3	3	2	3	2
M2	2	3	3	2	3
M3	2	3	2	3	3

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

PROGRAMME OUTCOMES [PO] FOR UNDER GRADUATE

At the end of the UG Programme, the student will be able:

PO1	Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Program of study.
PO2	Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
PO3	Critical thinking, analytical reasoning and inquiry methods: Capability to apply analytical reasoning, evaluate evidence, apply arguments, verify claims and beliefs on the basis of empirical evidence and appreciate intellectual property. Foster innovation and build Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of problems in real life situations.
PO4	Leadership readiness/qualities: Collaborate effectively and ethically coordinate with diverse teams, map task, set directions to achieve the vision.
PO5	Information/digital literacy: Capability to seek relevant e- resources, update scientific information and equip skills through ICT tools.
PO6	Lifelong learner: Become a responsible Global citizen and contribute towards environmental and sustainable development goals.

MAPPING OF POs TO PEOs

<u>PEO/PO</u>	PO1	PO2	PO3	PO4	PO5	PO6
PEO 1	3	2	3	2	2	2
PEO 2	3	2	2	3	3	3
PEO 3	2	3	2	3	2	2
PEO 4	3	3	3	2	3	3
PEO 5	3	2	3	3	2	2

CORRELATION: 3- STRONG 2- MEDIUM 1- LOW

PROGRAMME SPECIFIC OUTCOMES [PSO] FOR B.SC STATISTICS

PSO1	Gain the knowledge of statistical concepts and apply them in any domain.
PSO2	Create logical thinking and reasoning which enhance the capability of solving complex problems in Statistics to meet the opportunities of career development and higher studies.
PSO3	Recognize the importance of statistical modeling and computing, and mathematical approaches to analyze the real problems using various statistical tools.
PSO4	Apply the knowledge of statistical software to solve real world problems.
PSO5	Imbibe personal skills such as the ability to work both independently and in a group.

ELIGIBILITY FOR ADMISSION

Candidates for admission to B.Sc., Degree course in Statistics shall be required to have passed the Higher Secondary Examination (HSE), Conducted by the Government of Tamil Nadu or an examination accepted as equivalent there to by the Syndicate with Mathematics or Statistics or Business Mathematics as a subject of study.

DURATION OF THE COURSE

The UG course is of three years duration with six semesters.

Each academic year shall be divided into two semesters. The first academic year shall comprise the first and second semesters, the second academic year the third and fourth semesters and the third academic year as the fifth and sixth semesters.

The odd semester include the period from June to November and the even semester from December to April.

There shall not be less than 90 working days for each semester.

ELIGIBILITY FOR AWARD OF DEGREE

A Candidate shall be eligible for the award of the B.Sc., (Statistics) Degree only if he/she has undergone the prescribed course of study in a college affiliated to the University for a period of not less than three academic years, passed the examinations of all the six semesters prescribed, earning 142 credits and also fulfilled such conditions as may have been prescribed thereof.

SCHEME ON EXAMINATIONS

As per the University Regulation the following split up of marks are to be followed.

(i) Split Up for Internal and External Marks for Theory and Practical Paper:

Sl. No.	Paper	Internal	External	Total
1.	Theory	50	50	100
2.	Practical	50	50	100

(ii) Split Up for Internal Assessment Marks for Theory

CIE- Continuous Internal Evaluation (50 Marks)

CIA	30
Generic Skill	15
Attendance	5
Total	50

Course Structure

Part	Course	No. of Courses	Credits	Total Credit
I	Language	4	3	12
II	English	4	3	12
III	Core Course (Theory)	13	4	44
	Core Course (Practical)	5	2	14
	Generic Elective (Theory)	4	3	12
	Generic Elective (Practical)	2	2	4
	Core Project	1	4	4
	Discipline Specific Elective (DS)	3	3	9
	Multi-Disciplinary Elective	1	3	3
IV	Skill Enhancement Course – NME	2	2	4
	Skill Enhancement Course – DS	2	1	2
	Soft Skills	4	2	8
	Industrial Visit	1	1	1
	EVS	1	2	2
	Value Education	1	2	2
	Internship	2	2	2
V	Extension Activity	1	1	1
Total				142
Extra Credit Course – (MOOC Courses offered in SWAYAM / NPTEL)				
Extra Credit Course – (Value Added Courses)				

Consolidated Semester wise and Component wise Credit distribution:

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	11	11	14	14	23	21	94
Part IV	6	6	3	4	4	-	23
Part V	-	-	-	-	-	1	1
Total	23	23	23	24	27	22	142

DEPARTMENT OF STATISTICS
UG – SYLLABUS CONTAINS

1. Core Course (Theory) : 13 Papers
2. Core Course (Practical) : 5 Papers
3. Generic Elective (Theory) : 4 Papers
4. Generic Elective (Practical) : 2 Papers
5. Discipline Specific Elective : 3 (3) Papers
6. Multi-Discipline Elective : 1 Paper
7. Non-Major Elective : 2 Papers
8. Offer to Other Departments:
 - i. B. A., Sociology : 1 Paper
 - ii. B. Sc., Computer Science : 2 Papers
 - iii. B. Sc., Data Science : 4 Papers

DIFFERENT TYPES OF COURSES

List of Core Courses:

S. No.	Core Course (Theory)	Core Course (Practical)
1	CC1 – Descriptive Statistics	
2	CC2 – Mathematics for Statistics	
3	CC3 – Probability and Random Variables	
4	CC4 – Real Analysis	
5	CC5 – Distribution Theory	Core Practical I – Distribution Theory
6	CC6 – Estimation Theory	Core Practical II – Estimation Theory
7	CC7 – Testing of Hypothesis	Core Practical III – Testing of Hypothesis and Sampling Theory
8	CC8 – Sampling Theory	
9	CC9 – Reliability and Survival Analysis	
10	CC10 – R Programming	Core Practical IV – Statistical Data Analysis using R Programming
11	CC11 – Design of Experiments	Core Practical V – Design of Experiments and Statistical Quality Control
12	CC12 – Statistical Quality Control	
13	CC13 – Regression Analysis	

List of Generic Elective Courses:

- GE1: Applied Statistics (Theory) – **Semester I**
GE2: Computational Statistics with Excel (Theory) – **Semester II**
GE3: C Programming Language (Theory + Practical) – **Semester III**
GE4: Python Programming (Theory + Practical) – **Semester IV**

List of Discipline Electives:

- DSE (1) – (a) Numerical Methods
(b) Population Studies
(c) Official Statistics
DSE (2) – (a) Operations Research
(b) Biostatistics
(c) RDBMS with SQL for Data Analysis
DSE (3) – (a) Stochastic Processes
(b) Econometrics
(c) Actuarial Statistics

DSE (1) to be chosen as either (a) or (b) or (c) for Semester III

DSE (2) to be chosen as either (a) or (b) or (c) for Semester IV

DSE (3) to be chosen as either (a) or (b) or (c) for Semester VI

List of SEC – Department Discipline:

- SEC (DS Practical I): Descriptive Statistics – Practical **Semester I**
SEC (DS Practical II): Probability and Random Variables – Practical **Semester II**

List of Non-Major Electives:

- SEC NME I – Statistics for Competitive Examination – **Semester I**
SEC NME II – Quantitative Methods – **Semester II**

SEMESTER I

CORE COURSE – I

Course Title: **DESCRIPTIVE STATISTICS**

Course Code:	Credits : 4
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning objectives:

1. Know the uses of statistics in society.
2. Organize, manage and present data.
3. Analyse the statistical data graphically using frequency distribution and cumulative frequency distribution.
4. Analyse statistical data using measures of central tendency, dispersion and location.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Students come to know how to collect and classify the data and its limitations.
CO2	Students know how to Present/compare the data using Diagrams and Graph.
CO3	Students Come to know all Descriptive values of Statistics.
CO4	Students Know correlation analysis for different data and different methods.
CO5	Students has to know when apply the Regression Analysis.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	3	3	3	2	2
CO2	3	1	3	2	2	2	2	1	2	3
CO3	2	2	2	2	2	1	2	2	2	2
CO4	2	2	2	3	2	2	1	3	2	1
CO5	1	2	3	2	3	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	Cos
I	Nature and scope of statistical methods and their limitations – concepts of research design- primary and secondary sources of data - nominal, ordinal, ratio and interval scale - complete enumeration, observational studies and sample surveys.	13	CO1
II	Presentation by tables and diagrams – Construction of tables with one, two and three factors of classifications – Diagrammatic representations, frequency distributions for continuous and discrete data, graphical representation of a frequency distribution by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods) and Ogives.	13	CO2
III	Measures of location, dispersion, moments and measures of skewness and kurtosis for both grouped and ungrouped data.	13	CO3
IV	Correlation- Scatter diagram, Karl Pearson's co-efficient and its properties, Spearman's rank correlation coefficient, principle of least squares and fitting of first, second degree and exponential curves.	13	CO4
V	Regression Equations – properties of regression equations, regression lines and concept of error in regression – partial and multiple correlation – concepts. Association of attributes and simple problems.	13	CO5

Text Book:

1. S. P. Gupta (2021): Statistical Methods, 46th Edition, Sultan Chand & Sons.
2. P. R. Vittal and V Malini (2002): Mathematical Statistics, Margham Publications.

Books for Reference:

1. Goon, AM., Gupta M.K and Dasgupta B (1991): Fundamentals of Statistics, Vol.1, World Press, Calcutta.
2. M.R. Spiegel (1961): Theory and problems of statistics, Schaum's outline series
3. Bhat B.R, Srivenkataramana T, and Madhava K.S, (1996) Statistics: A Beginner's text Vol. I, New Age International (P) Ltd.
4. G.U. Yule and M.G. Kendall (1956): An introduction to the theory of Statistics, Charles Griffin.
5. Snedecor .G.W. and Cochran W.G. (1967): Statistical methods, Iowa State University Press.
6. Anderson, T.W. and Sclove SL. (1978): An introduction to statistical analysis of data, Houghton Mifflin co.
7. Croxton FE, and Cowden D.J. (1973) Applied General Statistics, Printice Hall of India.

Website Link:

1. https://www.tutorialspoint.com/class_11th_statistics_for_economics/index.asp
2. <https://www.surveysystem.com/correlation.htm>
3. <https://investopedia.com/terms/r/regression.asp>
4. <https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression>
5. https://course-notes.org/statistics/sampling_theory

CORE COURSE – II

Course Title: MATHEMATICS FOR STATISTICS

Course Code:	Credits : 4
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Course objectives:

1. To make understand the student about characteristic roots and vectors and reductions of quadratic
2. To obtain the knowledge of inverse of a matrix using Cayley Hamilton theorem and definite integrals.
3. To obtained knowledge of differentiation and Integration.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Compute the eigenvalues and eigenvectors of a square matrix and determine the dimension of the corresponding Eigen spaces.
CO2	Know the role of reciprocal equations in theory of equations.
CO3	Obtain the characteristic roots and vectors and C-H Theorem.
CO4	To obtain the knowledge of differentiations and its types.
CO5	To learned about successive differentiations and Properties of definite integrals – Reduction formula – Bernoulli's formula

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	2	2	2	2	2
CO2	2	3	2	2	3	2	2	2	2	3
CO3	3	2	3	2	2	2	2	2	2	1
CO4	2	2	3	2	2	2	3	2	2	2
CO5	2	2	2	2	3	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Vector spaces and subspaces - Null spaces, Column spaces and linear transformations - Linearly independent sets: Bases - Coordinate systems - The dimension of a vector space – Rank - Change of Basis. Orthogonality - Inner product, length and orthogonality - Orthogonal sets - Orthogonal projections.	13	CO1
II	Matrix theory-definition and type of matrices, scalar, Elementary, Symmetric, Skew-Symmetric, Hermitian, Skew - Hermitian, orthogonal and unitary matrices-algebraic operations on matrices and their properties.	13	CO2
III	Elementary transformations of matrices –determinant of matrix, definition of a row rank– column rank and rank of a matrix –determination of rank of a matrix - Inverse of a square matrix – Singular and non-singular matrix- computation of the inverse of the square matrix.	13	CO3
IV	Linear equations – Homogenous and non-homogenous systems of equations – consistency characteristic equations – Cayley –Hamilton theorem – eigen values and eigen vectors of a square matrix – Reducing quadratic form to canonical form.	13	CO4
V	Differentiation – Differentiation of implicit functions, Concavity, Convexity – Points of inflexion – Euler’s Theorem - Total differential coefficients (proof not needed) –Simple problems only. Integration – Properties of definite integrals – Reduction formula – Bernoulli’s formula, Beta and Gamma integration.	13	CO5

Text Book:

1. Narayanan and T. K. Manickavachagam Pillai (1996): Calculus (Vol I & II), S.V. Publications.
2. Shanti Narayanan: Differential and Integral Calculus, Chand & Co.

Books for Reference:

1. S. Narayanan and others, Calculus, S. Viswanathan publications.

Website Link:

1. <https://ocw.mit.edu/courses/res-18-006-calculus-revisited-single-variable-calculus-fall-2010/pages/study-materials/>
2. <https://www.khanacademy.org/math/calculus-1>
3. <https://byjus.com/maths/integration/>

GENERIC ELECTIVE – I

Course Title: APPLIED STATISTICS

Course Code:	Credits : 3
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning objectives:

1. To enable the students to understand time series, index numbers and apply them to various fields.
2. To introduce the basic statistical tools in time related variables and economic variables.
3. To learn the concept of Time series, evaluation of trends and measurement of seasonal variations by various methods.
4. To educate students about the importance of cost of living index numbers in real life problems.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	To gain knowledge about various Time series.
CO2	To solve the problems related to business and industries by using the method of averages.
CO3	To acquire knowledge of important of Time Series.
CO4	Execute the techniques for finding an Index number in real life situations.
CO5	To understand and solve the price Index problems.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3	2	3	2	2	3
CO2	2	2	2	2	2	2	2	2	1	3
CO3	3	2	2	2	1	2	2	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Time series – Definition and Utility of Time Series Analysis – Components of time Series – Additive and multiplicative models in Time Series.	9	CO1
II	Measurement of trend – Graphic Method – Method of semi averages – Method of Moving Averages and Method of Least square.	9	CO2
III	Measurement of seasonal variations – Method of Simple average - Ratio to moving average method by additive and multiplicative model - Ratio to trend - Link relative method.	9	CO3
IV	Index Numbers – Definition and Uses– Types of Index Number – Construction of Simple Index Numbers and problems - Simple Aggregate Method and Simple Average of Price Relative using A.M & G.M – Construction of Weighted index numbers – Tests of Adequacy of a Good Index Number – Time Reversal Test, Factor Reversal Test.	9	CO4
V	Cost of Living Index Number – Methods of Construction of Cost of Living Index Number – Aggregate Method – Family Budget Method – Uses of Cost Living Index Number - Fixed Base Index Numbers and Chain Base Index Numbers – Conversion of F.B.I to C.B.I and C.B.I to F.B.I.	9	CO5

Text Book:

1. Kapoor V. K and Gupta S. C (2007), Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.
2. Gupta S. P (2021), Statistical Methods, Sultan Chand & Sons, New Delhi.
3. Goon, A.M. Gupta, M.K., and Das Gupta, B. (1980): An outline of statistical theory, Vol.I, 6th revised edition. World Press limited, Calcutta.

Books for Reference:

1. Croxton, F.E and Cowdon, D.J. (1973): Applied general statistics, Prentice Hall
2. Parimal Mukhopadhyay, (1999), Applied Statistics, New Central Book Agency Pvt Ltd, Kolkata.
3. T.M.J.A. Cooray, Applied Time series Analysis and Forecasting, Narosha Publishing House.

Website Link:

1. <https://www.itl.nist.gov/div898/handbook/pmc4.htm>
2. https://stat.ethz.ch/education/semesters/ss2015/atsa/ATSA_Scriptum_v1_SS15.pdf
3. <https://www.ciciserviceindia.com/subject/Management/notes/index-numbers.html>
4. <https://thefactor.com/facts/management/statistics/index-number/1576/>
5. <https://www.undp.org/content/dam/india/docs/human-development/Introduction%20to%20Indian%20Statistical%20System.pdf>

SEC DISCIPLINE SPECIFIC PRACTICAL – I

Course Title: **DESCRIPTIVE STATISTICS – PRACTICAL**

Course Code:	Credits : 2
L : 1 T : 0 P : 3 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 50 Marks

Learning objectives:

1. Learn about constructions of Uni-variate, Bi-variate frequency distributions and applied problems practically.
2. Understand the concepts of Computation of correlation co-efficient, Rank correlation coefficient

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Students Come to know all Descriptive values of Statistics.
CO2	Students Know correlation analysis for different methods and Regression Analysis.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	3	3	3	2	2
CO2	3	1	3	2	2	2	2	1	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Practical Activities.
Teaching and Learning Methods	Practical with Calculator (Using Scientific Calculator).
Assessment Methods	Observation, Practical Note, Attendance, CIA and ESE.

Course Content:

1. Construction of Uni-variate frequency Distribution.
2. Construction of Bi-variate frequency Distribution.
3. To draw line, vertical and Horizontal, Multiple, Sub-Divided and Percentage bar Diagram.
4. To draw Histogram, Frequency Polygon and Frequency Curve.
5. To draw O-give and Lorenz Curve.
6. To calculate Arithmetic Mean, Median, Mode, G.M. and H.M. (Raw Data)
7. To calculate Arithmetic Mean, Median, Mode, G.M. and H.M. (Discrete Data)
8. To calculate Arithmetic Mean, Median, Mode, G.M. and H.M. (Continuous Data)
9. To calculate Range, M.D, Q.D, S.D, and Coefficient of Variation (Raw Data)
10. To calculate Range, M.D, Q.D, S.D, and Coefficient of Variation (Discrete Data)
11. To calculate Range, M.D, Q.D, S.D, and Coefficient of Variation (Continuous Data)
12. To calculate Karl Pearson's coefficient of Skewness-Bowley's coefficient of Skewness (Raw Data)
13. To calculate Karl Pearson's coefficient of Skewness-Bowley's coefficient of Skewness (Discrete Data)
14. To calculate Karl Pearson's coefficient of Skewness-Bowley's coefficient of Skewness (Continuous Data)
15. To calculate Kurtosis based on moments (Raw Data)
16. To calculate Kurtosis based on moments (Discrete Data)
17. To calculate Kurtosis based on moments (continuous Data)
18. To find Karl-Pearson's correlation coefficient for ungrouped data
19. To find Karl-Pearson's correlation coefficient for bivariate data
20. To find Spearman's Rank correlation coefficient (Direct Ranks are Given)
21. To find Spearman's Rank correlation coefficient (Indirect Ranks are Given)
22. To find Spearman's Rank correlation coefficient (Repeated Ranks are Given)
23. To calculate Regression coefficients and Regression equations.

Text Book:

1. S. P. Gupta (2021): Statistical Methods, 46th Edition, Sultan Chand & Sons.
2. P. R. Vittal and V Malini (2002): Mathematical Statistics, Margham Publications.

SEC NON MAJOR ELECTIVE – I

Course Title: STATISTICS FOR COMPETITIVE EXAMINATIONS

Course Code:	Credits : 2
L : 0 T : 2 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 90 Min.	ESE Marks : 50 Marks

Course Objectives:

1. To enable the students to understand the basic concept of statistics, collection of data, Presentation of data and analysis of data.
2. Understanding complex scenarios often presented in competitive exams across various Fields like business, economics, and social sciences.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	To know how to collect and classify the data and its limitations.
CO2	To analyze and present / compare the data using diagrams and charts.
CO3	Students come to know measures of location.
CO4	Students come to know measures of dispersion.
CO5	Students know correlation with different methods and regression analysis.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	1	2	2	2	3	1
CO2	2	3	2	1	3	2	2	2	2	3
CO3	3	2	1	2	2	2	2	2	1	2
CO4	2	2	3	2	2	2	3	2	2	2
CO5	2	2	2	1	3	2	2	1	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Definition and uses of statistics – Scope and limitation of statistics – Collection of data - Primary and Secondary data – Classification and Tabulation of data.	6	CO1
II	Diagrammatic presentation and Graphical representation – simple problems.	6	CO2
III	Measures of location – Arithmetic mean, median, mode, Geometric mean and harmonic mean – Simple Problems.	6	CO3
IV	Measures of Dispersion – Range – Quartile Deviation – Mean Deviation – Standard Deviation and Coefficient of variation – Skewness and Kurtosis – Simple Problems.	6	CO4
V	Definition of correlation – Types – Regression Lines and Regression Equations – Difference between correlation and Regression – Simple Problems.	6	CO5

Text Book:

1. Gupta. S. P. (2001), Statistical Methods, Sultan Chand & Company Ltd., New Delhi.
2. Vittal. P. R, Business Statistics, Margham Publications, Chennai.

Books for Reference:

1. Pillai. R. S. N and Bagavathi. V. (2005), Statistics, S. Chand & Company Ltd., New Delhi.
2. Sancheti. D. C. and Kapoor. V. K., 7th Edition, Sultan Chand & Sons, New Delhi.
3. Agora. P. N, Comprehensive Statistical Methods, Sultan Chand & Sons, New Delhi.
4. Agarwal. B. L., Basic Statistics, Willey Eastern Ltd., Publishers, New Delhi.

Website Link:

1. <https://www.tutorialspoint.com/statistics/>
2. <https://www.emathzone.com/tutorials/basic-statistics/collection-of-statistical-data.html>

SEMESTER II

CORE COURSE – III

Course Title: **PROBABILITY AND RANDOM VARIABLES**

Course Code:	Credits : 4
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. Identify Random experiments in real life data and translate real-world problems into probability models.
2. Understand the use of basic probability rules, including additive and multiplicative laws, independent and mutually exclusive events.
3. Derive the probability density function of transformation of random variables.
4. Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To know the principles of Probability.
CO2	To solve the problems based on discrete and continuous random variables.
CO3	To know the concept of Bivariate distributions.
CO4	To know the concept of Mathematical Expectation and Variance.
CO5	To understand the concept of MGF, CGF, CLT.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	1	2	2	2	3	2	1
CO2	2	3	3	3	3	2	2	2	3	2
CO3	2	3	3	2	3	3	3	2	3	3
CO4	3	1	1	3	3	1	2	1	3	2
CO5	3	1	1	2	2	1	3	1	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Random experiment-Trial, Sample point, Sample space, Event, Algebra of Events, Definition of Probability Classical, Relative Frequency and Axiomatic approach, Properties of probability. Theorems on probability – Addition and Multiplication theorem of probabilities, Conditional Probability, Independence of events – Baye's theorem - simple problems.	13	CO1
II	Concept of Random variables: Definition of Discrete and Continuous random variables – Probability mass function, Probability density functions – Distribution functions and their properties – simple problems.	13	CO2
III	Joint probability functions – Joint Probability mass function – Joint probability density function – Marginal and Conditional Probability function – Cumulative distribution function of bivariate random variables and their properties – Marginal, Conditional, distribution function and density function – Independence of Random variables – Properties of joint distribution function – Simple Problems.	13	CO3
IV	Definitions of Expectation (Discrete and Continuous) – Theorems on expectations, Moments, Variance and their Properties – Conditional expectation and Conditional variance – Chebychev's Inequality – Simple Problems.	13	CO4
V	Definition of Moment generating function – Properties, Characteristic functions – Cumulants – Properties, Central Limit Theorem – Lindeberg-Levy, Demoivre's (statement only) – Simple Problems.	13	CO5

Text Book:

1. Gupta, S.C., and Kappor, V. K. (2020). Fundamentals of Mathematical Statistics, 12th Edition, Sultan Chand & Sons (Publisher), New Delhi, India.
2. A.M.Mood, F.A. Graybill and D.C. Boes (1974): Introduction to the theory of Statistics, International student. McGraw Hill.

Books for Reference:

1. P.G.Hoel (1971): Introduction to Mathematical Statistics, Asia publishing house.
2. Murry R. Spiegel (1982): Theory and problems of Probability and Statistics, Schaum's outline series, McGraw Hill.
3. Seymour Lipshutz (1982): Theory and problems of probability, Schaum's outline series, McGraw Hill.
4. K.L.Chung (1983): Elementary probability theory with stochastic processes, Springer International student edition.
5. William.Feller (1968): An introduction to probability theory and its applications, Vol. I, 3rded., John Wiley & Sons.

Website Link:

1. <https://seeing-theory.brown.edu/probability-distributions/index.html>
2. <https://www.kullabs.com/classes/subjects/units/lessons/notes/note-detail/9557>
3. <https://www.statisticssolutions.com/mathematical-expectation/>
4. <http://itfeature.com/statistics/measure-of-dispersion/moments-in-statistics>

CORE COURSE – IV

Course Title: REAL ANALYSIS

Course Code:	Credits : 4
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. To make understand the student about Set, function, real valued, function and limit concepts.
2. To obtain the knowledge of convergence, divergence. Differential and Integral Calculus.
3. To obtain the knowledge of Laplace transforms and inverse Laplace transforms.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	To learn about the basics of Real Numbers and limits concepts.
CO2	To gain the knowledge of convergence and divergence and test based on these concepts.
CO3	To learn about continuity, Mean value theorem, Roll's theorem and Taylor's theorem.
CO4	To understand the concept of Riemann integrals and its problems.
CO5	To learn about Laplace transforms and inverse Laplace transforms.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	3	2	2	3	2	3	1	2
CO2	2	3	3	1	2	3	2	3	2	2
CO3	2	2	2	2	3	1	2	2	2	3
CO4	2	2	2	3	2	2	3	2	3	2
CO5	3	2	2	2	3	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Fundamental concepts: Sets and elements, Operations on sets – Real valued functions – Countability – Definition of sequence and subsequence, Limit of a sequence, Convergent sequences, Divergent sequences, Bounded sequences, Monotone sequences, limit superior and limit inferior of a sequence.	13	CO1
II	Series: Convergence and Divergence of a series – Series with non-negative terms, comparison test, Comparison test by limits, D' Alembert's ratio test and Cauchy's root test. Alternating series- Leibnitz test, Conditional convergence and absolute convergence of alternating series, Simple problems.	13	CO2
III	Differential Calculus: Concept of Derivatives – Algebra of derivatives, Rolle's theorem, Mean value theorem, Taylor's Theorem – Maclaurin Series.	13	CO3
IV	Integral Calculus: Riemann integrals, Necessary and Sufficient condition for Riemann integral, Darboux theorem, Fundamental theorem of integral calculus – First mean value theorem.	13	CO4
V	Laplace transformation (LT) – definitions, LT of the function t , e^{at} , e^{-at} , $\cos at$, $\sin at$, $e^{at}\cos bt$, $e^{at}\sin bt$, transform $f'(t)$, $f''(t)$ - Inverse LT relating to the standard functions.	13	CO5

Text Book:

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

Books for Reference:

1. Narayanan and T. K. Manickavachagam Pillai – Ancillary Mathematics Book II
2. Bartle R. G and Shebert, D. R. (1982): Introduction to Real Analysis, Wiley Eastern & Sons.
3. Malik, S.C. and Savita Arora (1991). Mathematical Analysis, Wiley Eastern Limited, New Delhi.
4. Sanjay Arora and Bansi (1991). Introduction to Real analysis, Satya Prakashan, New Delhi.

Website Link:

1. <http://www.ms.uky.edu/~droyster/courses/fall06/PDFs/Chapter06.pdf>
2. <https://tutorial.math.lamar.edu/classes/calci/thelimit.aspx>
3. <https://www.mathsisfun.com/calculus/derivatives-introduction.html>
4. <https://www.math.ucdavis.edu/~hunter/m125b/ch1.pdf>
5. <https://math.hmc.edu/calculus/hmc-mathematics-calculus-online-tutorials/single-variable-calculus/taylors-theorem/>

GENERIC ELECTIVE – II

Course Title: COMPUTATIONAL STATISTICS WITH EXCEL

Course Code:	Credits : 3
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

The course aims to provide data handling experience using MS- Excel

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To understand the importance of excel application.
CO2	To acquire knowledge on data entry and manipulate data in excel sheet.
CO3	To Can perform data pre-processing and data analytics with the acquired statistical knowledge.
CO4	To Study the basic features and features for data analytics of excel.
CO5	To Study the basic mathematical and descriptive statistics for data analytics of excel.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	1	3	2	2	2
CO2	3	1	3	3	1	2	1	1	2	3
CO3	2	2	2	2	2	2	2	2	2	2
CO4	2	2	2	3	2	2	3	3	2	1
CO5	2	2	1	2	2	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Introduction: Excel Environment - Menus, Tool bars and icons, Spreadsheet application, Create, save and switch between spreadsheets, formatting Spreadsheet-Manipulating Text.	9	CO1
II	Entering and editing data in Spreadsheet - Import data from web – Filtering and sorting data in excel – Creating hyperlinks – Cell referencing – Diagrams and graphs – Set print area – printing.	9	CO2
III	Data Pre-processing – Data Cleaning – Data normalization, Integration and transformation – Pivot tables – Heat Maps.	9	CO3
IV	Excel functions and Formula – Logical functions – Test functions – Basic Statistical functions (Measures of central tendency, Location Parameters, Measures of dispersion, Skewness and Kurtosis).	9	CO4
V	Basic mathematical functions – Statistical Tools – Descriptive Statistics, Correlation, Regression – Other Statistical Tools – Random number generation, Time Series.	9	CO5

Text Book:

1. Michael Olafusi (2015), Microsoft Excel and Business Data Analysis for the Busy Professional, Microsoft Excel.
2. Joseph Schmuller (2013), Statistical Analysis with Excel for Dummies, 4th Edition, Wiley.
3. Rudy LeCorps (2002), Microsoft Excel fundamentals, A practical workbook for beginners and Advanced Users, RGL Publishing.

Books for study reference:

1. Vijay Gupta (2002), Statistical Analysis with Excel, Excel for Professionals, VJ Books Inc, Canada.
2. Bernd Held (2006), Microsoft Excel Functions and Formulas, Wordware Publishing, Inc.
3. Jordan Gold Meier and Purnachandra Duggirala (2015), Dashboards for excel, Apress.
4. Microsoft excel 2019-Step by Step, Curtis Frye, Microsoft press store.
5. Salvador Garcia, Julian Luengo and Francisco Herrera (2015), Data Pre-processing in Data Mining, Springer.
6. Neil J. Salkind: Excel Statistics: A Quick Guide.

Website Link:

1. <https://www.udemy.com/basic-excel/promo>
2. <https://www.linkedin.com/learning/excel>
3. <https://www.udemy.com/course/statistics-using-excel>
4. https://www.tutorialspoint.com/advanced_excel_functions/advanced_excel_statsiticsl_function.htm

SEC DISCIPLINE SPECIFIC PRACTICAL – II

Course Title: PROBABILITY AND RANDOM VARIABLES – PRACTICAL

Course Code:	Credits : 2
L : 1 T : 0 P : 3 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 50 Marks

Learning Objectives:

1. Learn about probability in real life situations and applied problems practically.
2. Practical knowledge in random variables and Bayes theorem.
3. Understand marginal and conditional probability distribution function.
4. Learn about expectations and conditional expectations.
5. Understand the concept of Chebychev's inequality.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To solve the problems based on discrete and continuous random variables.
CO2	To know the concept of Mathematical Expectation and Variance.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	1	2	2	2	3	2	1
CO2	2	3	3	3	3	2	2	2	3	2

3-Strong 2-Medium 1-Low

Tutorial Schedule	Practical Activities.
Teaching and Learning Methods	Practical with Calculator (Using Scientific Calculator).
Assessment Methods	Observation, Practical Note, Attendance, CIA and ESE.

Course Content:

1. Problems based on Addition theorem of Probability.
2. Problems based on Multiplication theorem of Probability.
3. Problems based on Bayes' theorem.
4. To find probability mass and density function.
5. To find distribution function.
6. To find joint probability density and distribution function (discrete random variables).
7. To find joint probability density and distribution function (continuous random variables).
8. To find raw and central moments.
9. To find raw and central moments based on joint probability density function.
10. To find Marginal and Conditional probability distribution function (discrete random variables).
11. To find Marginal and Conditional probability distribution function (continuous random variables).
12. Problems based on Expectations.
13. Problems based on Conditional expectations.
14. Problems based on Conditional variance using expectation.
15. Problems based on Chebychev's inequality.
16. Problems based on moment generating function.
17. Problems based on Characteristic function.
18. Problems based on moment generating function using joint density function.
19. Problems based on moment characteristic function using joint density function.
20. Problems based on central limit theorem.

Text Book:

1. Gupta, S.C., and Kappor, V. K. (2020). Fundamentals of Mathematical Statistics, 12th Edition, Sultan Chand & Sons (Publisher), New Delhi, India.
2. A.M.Mood, F.A. Graybill and D.C. Boes (1974): Introduction to the theory of Statistics, International student. McGraw Hill.

SEC NON MAJOR ELECTIVE – II

Course Title: QUANTITATIVE METHODS

Course Code:	Credits : 2
L : 0 T : 2 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 90 Min.	ESE Marks : 50 Marks

Learning Objectives:

1. To enable the students to understand the concept of probability.
2. To learn the concept of random variables, distribution function, mathematical expectation.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	To gain knowledge about probability.
CO2	To learn and solve the random variable.
CO3	To acquire knowledge of the importance and solve the probability distributions.
CO4	To execute marginal conditional distribution techniques in real-life situation.
CO5	To understand the concept of expectation.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2	2	1	2	3	1
CO2	2	2	2	1	3	2	2	2	2	3
CO3	3	2	1	2	2	2	2	2	1	2
CO4	3	2	3	2	2	2	3	2	2	2
CO5	2	2	2	2	3	2	2	1	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Permutation and Combination: Fundamental Principle of counting – Meaning of Permutation – Rules of Permutation (Permutation with Repetitions, Permutation of n things not all different, Circular permutation, Rule of Counting, Restricted Permutations), Combinations – Rules of Combination, Restricted Combinations – Simple problems based on competitive exam.	6	CO1
II	Probability: Probability Concept – Rules of Probability, Independent Events, Baye's Rule, Random Variable – Simple problems based on competitive exam.	6	CO2
III	Time Series: Introduction of Time Series – Components of a Time Series – Analysis of a Time Series – Measurement of Secular Trend – Measurement of Seasonal Variation – Forecasting with Moving Average and Least Square Method – Simple problems based on competitive exam.	6	CO3
IV	Index Number: Uses of Index Number – Constructions of Index Number (simple aggregating index number, weighted aggregative index number, simple average of relative index number, weighted average of relative index number) – Simple problems based on competitive exam.	6	CO4
V	Linear Programming: Definitions, Application of Linear Programming, Types of Linear Programming Problems, Formulation on L.P.P, Solution of L.P.P by graphical methods, Transportation Problems, IBFS by North-West Corner Method, Least Cost Method, Vogel's Approximation Method, Assignment Problem and its Solution – Simple problems based on competitive exam.	6	CO5

Text Book:

1. P.R.Vittal, Mathematical Statistics, Margham Publications, Chennai 2013.
2. O.P. Gupta & Vishal Sharma, Mathematical Statistics, Revised Edition, Mohan Print Media (P) Ltd., Meerut, 2019.
3. Kanthi Swarup, PK Gupta and Man Mohan, Operations Research, 20th revised Edition, Sultan Chand & Sons, 2022.

Books for Reference

1. Gupta S.P. & Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 12th Edition 2020.
2. P.G.Hoel (1971): Introduction to Mathematical Statistics, Asia publishing house.
3. Murry R. Spiegel (1982): Theory and problems of Probability and Statistics, Schaum's outline series, McGraw Hill.

Website Link:

1. <https://seeing-theory.brown.edu/probability-distributions/index.html>
2. <https://www.kullabs.com/classes/subjects/units/lessons/notes/note-detail/9557>
3. <https://www.statisticssolutions.com/mathematical-expectation/>
4. <http://itfeature.com/statistics/measure-of-dispersion/moments-in-statistics>
5. <https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library>

SEMESTER III

CORE COURSE – V

Course Title: **DISTRIBUTION THEORY**

Course Code:	Credits : 4
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning objectives:

1. Understand the basic concept of Probability distribution and density function.
2. Identify the characteristics of different discrete and continuous distributions.
3. Identify the type of statistical situation to which different distributions can be applied.
4. Comprehend the Sampling distributions.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To know the problem of discrete distributions – Bernoulli distribution and Binomial distributions.
CO2	To know the problem of discrete distributions – Poisson and Geometric distribution.
CO3	To solve the continuous distributions – Normal distribution its constants and fitting of normal distribution.
CO4	To solve the continuous distributions – Rectangular, Exponential, Beta Distribution with First kind and Second kind and Gamma Distribution.
CO5	To know the sampling distributions: Chi-square, Student's t and F distributions.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2	1	3	2	2	2
CO2	3	1	3	3	1	2	1	1	2	3
CO3	1	2	2	2	2	2	2	2	2	2
CO4	2	2	2	3	2	2	3	3	2	1
CO5	2	2	1	2	2	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Discrete distributions: Bernoulli distribution: Introduction, Mean and variance, Binomial Distribution: Introduction – mean and variance, Moments, Recurrence relation for the moments, Mean deviation about mean, Mode, Moment Generating Function, Additive property, Cumulants, Recurrence relation for Cumulants, Fitting of Binomial Distribution.	13	CO1
II	Poisson distribution: Introduction – Conditions for Binomial distribution tends to Poisson distribution, Mean and variance, M.G.F., Recurrence relation for probabilities and moments, Fitting of Poisson distribution. Geometric Distribution: Introduction, Lack of memory concept, MGF, Moments.	13	CO2
III	Continuous distributions: Normal Distribution: Introduction, Limiting case of Binomial distribution, Chief Characteristics and Normal probability curve, Mean, Median, Mode, Moment generating function, Cumulant generating function, Characteristic function, Moments, Points of inflexion, Mean deviation, Area property, Importance of Normal distribution, Fitting of Normal distribution.	13	CO3
IV	Rectangular Distribution: Introduction, M.G.F, Moments, Mean deviation about mean. Exponential Distribution: Definition, MGF, Mean, Variance, Characteristic function, Lack of Memory property. Beta Distribution: First kind and Second kind - M.G.F, Mean, Moments. Gamma Distribution: M.G.F, Mean, Moments, Relationship between Beta and Gamma Distributions.	13	CO4
V	Sampling Distributions – Concept – Chi-square, Student's t and F distributions - Derivation of t, F and chi-square distributions with properties – Relation among t, F and chi-square distributions.	13	CO5

Text Book:

1. Gupta S.P. & Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 12th Edition 2020.
2. Parimal Mukhopadhyay, (1996), Mathematical Statistics, New Central Book Agency.
3. Dhanavanthan P. Sakthivel K. M. (2025), Elementary Theory of Probability Distributions, Ane Publishers and Distributions LLP.

Books for Reference:

1. Hogg, R. V and Craig, A. T (2002), Introduction to Mathematical Statistics, Pearson Education Asia, India.
2. A. M. Mood, F. A. Graybill and D. C. Boes (1974): Introduction to the theory of Statistics, International student ed. McGraw Hill.
3. Goon, AM., Gupta M.K and Dasgupta B (1991): Fundamentals of Statistics, Vol.1, World Press, Calcutta.

Website Link:

1. <https://www.statisticshowto.datasciencecentral.com/>
2. <https://online.stat.psu.edu/stat504/node/209/>
3. <https://www.colorado.edu/amath/sites/default/files/attached-files/ch4.pdf>
4. https://www.cimt.org.uk/projects/mepres/alevel/stats_ch7.pdf
5. <https://www.investopedia.com/terms/c/chi-square-statistics.asp>

CORE PRACTICAL – I

Course Title: **CORE PRACTICAL I – DISTRIBUTION THEORY**

Course Code:	Credits : 2
L : 1 T : 0 P : 2 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 50 Marks

Learning Objectives:

1. Learn about distributions and applied problems practically.
2. Understand the concepts of Chi-square distribution and F-distribution.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To solve the problems of discrete distributions.
CO2	To solve the problems of continuous distributions.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	2	2	1	3	2	2	2
CO2	3	1	3	3	1	2	1	1	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Practical Activities.
Teaching and Learning Methods	Practical with Calculator (Using Scientific Calculator).
Assessment Methods	Observation, Practical Note, Attendance, CIA and ESE.

Course Content

1. Fitting of Binomial distribution direct method.
2. Fitting of Binomial distribution Recurrence relation method.
3. Fitting of Binomial distribution when parameters are given (when the coin is unbiased).
4. Fitting of Binomial distribution when parameters are not given (when the coin is biased).
5. Fitting of Binomial distribution computing mean and variance and testing the goodness of fit.
6. Application problems based on Binomial distribution.
7. Fitting of Poisson distribution direct method.
8. Fitting of Poisson distribution Recurrence relation method.
9. Fitting of Poisson distribution when parameters are given.
10. Fitting of Poisson distribution when parameters are not given.
11. Fitting of Poisson distribution computing mean and variance and testing the goodness of fit.
12. Application problems based on Poisson distribution.
13. Fitting of Geometric distribution.
14. Fitting of Geometric distribution computing parameter and testing the goodness of fit.
15. Fitting of Normal distribution when parameters are given.
16. Fitting of Normal distribution when parameters are not given.
17. Fitting of Normal distribution computing mean and variance and testing the goodness of fit (area property).
18. Fitting of Normal distribution computing mean and variance and testing the goodness of fit (ordinate property).
19. Application based problems using Normal distribution.
20. Fitting of Exponential distribution computing parameter and testing the goodness of fit.

Text Book:

1. Gupta S.P. & Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 12th Edition 2020.
2. Parimal Mukhopadhyay, (1996), Mathematical Statistics, New Central Book Agency.
3. Dhanavanthan P. Sakthivel K. M. (2025), Elementary Theory of Probability Distributions, Ane Publishers and Distributions LLP.

GENERIC ELECTIVE – III

Course Title: C PROGRAMMING LANGUAGE

Course Code:	Credits : 3
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. Explain the basic concepts and structure of C Language.
2. Discuss the concept of Looping and Decision Making statements.
3. Describe the concept of arrays and its applications in Statistics.
4. Point out the parameters, functions and pointers in Data Analytics.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	To know the basic concepts, data types and operators of C.
CO2	To know the concept of standard input and output functions.
CO3	To know the concepts of control structure, looping and functions.
CO4	To know the concept of arrays and strings.
CO5	To know the concept of functions.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	2	2	2	2	2
CO2	3	3	2	2	3	2	2	2	2	3
CO3	3	2	3	2	2	2	2	2	2	2
CO4	2	2	3	2	2	2	3	2	2	2
CO5	2	2	2	2	3	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Introduction To C - Overview of C – Importance of C – Structure of C Program – Programming Style – Process of Executing a C Program – Constants – Variables – Data Types – Character Set – C Tokens – Keywords – Identifiers – Declaration of Variables – Assigning Values to Variables – Symbolic Constants.	9	CO1
II	Operators and Expression - Arithmetic Operators – Relational Operators – Logical Operators – Assignment Operators – Conditional Operators – Increment and Decrement Operators – Library Function – Managing Input and Output Statements: Single Character Input – getchar() Function – putchar() function – scanf() function – Output functions – printf() function – gets() and puts() function.	9	CO2
III	Decision Making and Branching – Decision Making with if Statement – if – else Statement – Nesting if-else Statement – Switch Statement – Break – Continue Statement – Looping and Branching Using While Statement – Do-While Statement – For Loop Statement – Syntax and Simple Examples.	9	CO3
IV	Arrays and String - One Dimensional Arrays – Declaration – Initialization – Two Dimensional Arrays – Syntax – Initialization (Concepts only). Declaring and initializing string variables – Arithmetic operations on Character – String handling functions.	9	CO4
V	User Defined Functions – Need – Multi-Function Program – Elements of User Defined Functions – Definition of Functions – Function Calls – Return Types – Declaration – Category of Functions – Function Program to Sort an Array of Integers.	9	CO5

Text Book:

1. Balagurusamy, E. (1997): ANSI C Programming, Tata-Mc Graw Hill Publishers Ltd.
2. B. W. Kernighan, D. M. Ritchie C programming Language 2nd Edition,

Books for Reference:

1. Yaswant Kanetkar (1997): Let Us C, BPB Publications, New Delhi.
2. Bruce, H. Hunter: Introduction to C. K.N. King, C Programming – A Modern Approach.

Website Link:

1. <https://ndupress.ndu.edu/>
2. <https://nptel.ac.in/courses/106/105/106105171/>

GENERIC ELECTIVE PRACTICAL – I

Course Title: PROGRAMMING IN C

Course Code:	Credits : 2
L : 1 T : 0 P : 3 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Course outcomes:

1. Explain the theory through practical oriented training.
2. Performing the basic operations of C language.
3. Apply the C Language for Data Analytics and Access the data through Arrays.
4. Compute model fitting by developing programs.
5. Develop computation skills for Statistics and Data Analytics.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	To know the concepts of control structure, looping and functions.
CO2	To know the basic statistical concepts.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	2	2	2	2	2
CO2	3	3	2	2	3	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Practical Activities.
Teaching and Learning Methods	Practical with System (Computer Lab).
Assessment Methods	Observation, Practical Note, Attendance, CIA and ESE.

Course Content:

1. Program to find factorial of n numbers.
2. Program to find the sum of series $1 + 1/2 + 1/3 + \dots + 1/n$.
3. Program to determine the roots of equation of the form $ax^2 + bx + c$.
4. Program to generate Fibonacci sequence.
5. Program to find String Manipulation (Counting the no. of vowels, consonants, words, whitespaces in a line of text and array of lines).
6. Program to check reverse a string & check for palindrome.
7. Program to find Matrix Addition.
8. Program to find Matrix Multiplication.
9. Program to find Transpose of a matrix.
10. Program to find frequency count.
11. Program to find Binomial Coefficient nC_x .
12. Program to determine the value of Mean for raw data.
13. Program to determine the value of Median for raw data.
14. Program to determine the value of Mode for raw data.
15. Program to determine the value of Variance and Standard Deviation for raw data.
16. Program to determine the value of Range.
17. Program to find Skewness.
18. Program to find Kurtosis.
19. Program to calculate Correlation coefficient.
20. Program to determine the regression equations.

Text Book:

1. Balagurusamy, E. (1997): ANSI C Programming, Tata-Mc Graw Hill Publishers Ltd.
2. B. W. Kernighan, D. M. Ritchie C programming Language 2nd Edition,

DISCIPLINE SPECIFIC ELECTIVE – I (A)

Course Title: NUMERICAL METHODS

Course Code:	Credits : 3
L : 2 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. To impart the knowledge of finite difference, interpolations and Numerical differentiation.
2. To obtain the knowledge of Numerical integration.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Understand the concept of Gauss elimination and Gauss Jordan method.
CO2	Learn about interpolations with equal intervals and finite differences.
CO3	To know the concept of Central difference interpolation formula.
CO4	To learn and solve the problems of Interpolation with unequal intervals.
CO5	Understand the concept of numerical differentiation and Numerical integration.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	2	2	2	3	2
CO2	2	3	2	2	3	2	2	2	2	3
CO3	3	2	2	2	2	2	2	2	2	2
CO4	2	2	3	2	2	2	3	2	2	2
CO5	2	2	2	2	3	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Simultaneous equations: Direct methods: Gauss Elimination method – Gauss-Jordan method. Iteration methods: Gauss-Jacobi method – Gauss Seidel method.	9	CO1
II	Finite differences-forward and backward differences, operators E and Δ and their basic properties, Interpolation with equal intervals: Newton's forward and backward differences – simple problems.	9	CO2
III	Central difference interpolation formula-Gauss forward and backward differences formulae – Stirling's, Besse's and Laplace – Everett's formulas – simple problems only.	9	CO3
IV	Interpolation with unequal intervals: Divided differences and their properties, Newton's divided differences formula – Lagrange's formula – simple problems. Inverse interpolation: Iteration or successive approximation method – Lagrange's method – simple problems.	9	CO4
V	Numerical differentiation: Numerical Derivatives up to 2 nd order (equal intervals only) – simple problems. Numerical integration: Trapezoidal rule – Simpson's 1/3 rd and 3/8 th rules – Weddle's rule – Euler's summation formula.	9	CO5

Text Book:

1. B.D. Gupta, Numerical Analysis, Konark Publishing.
2. Saxena, Calculus of finite differences and Numerical Analysis S. Chand & Co.

Books for Reference:

1. Gupta-Malik, Krishna Prakastan Mandir, Calculus of finite differences and Numerical Analysis, Meerut.
2. M. K. Venkataraman, Numerical methods in Science and Engineering, National publishing house, Chennai.
3. M. M. Ramasamy and Palaniappan, Numerical mathematics.

Website Link:

1. https://onlinecourses.nptel.ac.in/noc21_ma45/preview
2. <https://archive.nptel.ac.in/courses/111/107/111107105/>

DISCIPLINE SPECIFIC ELECTIVE – I (B)

Course Title: DEMOGRAPHY

Course Code:	Credits : 3
L : 2 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. To identify appropriate sources of data with basic vital statistics analysis.
2. To relate the population with standardized death rates.
3. To utilize the mortality table to find the survival and death rates.
4. To analyse the birth rate used to describe fertility in the populations.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Identify appropriate sources of data with basic vital statistics analysis.
CO2	Relate the population with standardized death rates.
CO3	Utilize the mortality table to find the survival and death rates.
CO4	Analyse the birth rate used to describe fertility in the populations.
CO5	Distinguish between Incidence and Prevalence rates.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	2	2	2	3	2
CO2	2	3	2	2	3	2	2	2	2	3
CO3	3	2	2	2	2	2	2	2	2	2
CO4	2	2	3	2	2	2	3	2	2	2
CO5	2	2	2	2	3	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Introduction: Definition, nature and scope of Population Studies, relationship of other social sciences with population studies – Advantages of Population Study.	9	CO1
II	Concept of Natural Increase of Population and Growth of Population – Measurement and Indicators of Demographic Determinants: Fertility, Mortality, Migration, Marriage.	9	CO2
III	Vital Statistics: Definition, Nature, Scope and Methods of vital statistics data - Measurement of Population – Development of Population Studies in India.	9	CO3
IV	Risk Measures: Ratios, Proportions and Rates – its properties, uses and simple problems; Morbidity Rates: Incidence proportions, Incidence rates, Prevalence rates – Definition, properties, uses and simple problems.	9	CO4
V	Fertility Rates: Crude Birth Rate – General Fertility Rate – Age Specific Fertility Rate – Total Fertility Rate – Gross Reproduction Rate (GRR) – Net Reproduction Rate (NRR) – Replacement level Fertility – Birth order statistics – Child Women ratio – Order Specific Fertility Measures – Theory and simple Problems.	9	CO5

Text Book:

1. Gupta, S.C. and V.K. Kapoor (1978): Fundamentals of Applied Statistics, Sultan Chand & Sons.
2. Agarwal S.N, India's Population Problems, Tata McGraw Hill, 1981.
3. Srivastava, O.S (1983): A text book Demography, Vikas Publishing.

Books for Reference:

1. Bogue, Donald, J (1976): Principles of Demography, John Wiley, New York.
2. Mukhopadhyay, P. (2011): Applied Statistics, Second Edition, Books and Allied (P) Ltd., India.
3. Spieglemen, M. (1968): Introduction to Demography, Harvard University Press.
4. Mishra, B. D. (1980): An Introduction to the Study of Population, South Asian Publishers Pvt. Ltd., New Delhi.
5. Barclay, G. W. (1958): Techniques of Population Analysis, John Wiley and Sons, New York.

Website Link:

1. <https://www.stat.berkeley.edu/~bartlett/courses/153-fall2010/lectures/1.pdf>
2. <http://www.gdcboysang.ac.in/About/droid/uploads/EconomicsPart4.pdf>
3. <https://www.youtube.com/watch?v=AlpkMAwQpWc>
4. https://www.youtube.com/watch?v=_gy3IZ2FBuI
5. <https://www.youtube.com/watch?v=ZArGanRzyT8>

DISCIPLINE SPECIFIC ELECTIVE – I (C)

Course Title: OFFICIAL STATISTICS

Course Code:	Credits : 3
L : 2 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. Understanding the functioning of statistical organization in India.
2. Deep knowledge in the concepts of official statistics.
3. Study basic fundamentals of agricultural and industrial statistics.
4. Review the ideas of index numbers and its usages.
5. Impart the understanding of national income and its measures.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Recognize the Statistical organisations of India.
CO2	Understand the existing price statistics.
CO3	Acquire the Knowledge on Indian Official Statistical System.
CO4	Estimate the national income using different methods.
CO5	Examine different methods of collecting population census.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3	3	3	3	3	3
CO2	2	2	2	2	2	3	3	3	2	3
CO3	3	2	2	2	1	3	3	3	3	3
CO4	2	3	3	3	2	2	3	3	3	3
CO5	2	2	1	2	2	3	3	3	3	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Official Statistics: Definition – Growth of Indian Statistics – Statistical organizations of India: Central Statistical Organisation (CSO) – Divisions of Central Statistical Organisation – Functions – Publications.	9	CO1
II	National Sample Survey Organisation (NSSO): Divisions of NSSO – Functions of NSSO – Procedure for collection of information – Agriculture Statistics, Yield Statistics – Official series: Traditional method, Random Sampling Method – NSS Series – Forest Statistics, Fisheries Statistics – Defects in agricultural Statistics.	9	CO2
III	National income: Definition – Methods of estimating national income: The Income method, the Output method and the Expenditure method – Uses of National income estimates – Difficulties of estimation.	9	CO3
IV	Social accounting: Population statistics – Sources – Different methods of collecting population census – Methods of enumeration – Merits and demerits of De Facto method, Merits and demerits of the De Jure system.	9	CO4
V	Price Statistics: Wholesale prices, Retail prices, Uses and limitations of price statistics. Industrial Statistics: Main Sources of industrial Statistics – Limitations.	9	CO5

Text Book:

1. R.S.N. Pillai and V. Bagavathi, Statistics, 3rd Edition, S.Chand & Company, New Delhi, 1995.
2. Central Statistical Organization, Statistical Systems in India, Department of Statistics, Ministry of Planning, New Delhi, 2011.

Books for Reference:

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

Website Link:

Unit-I 14.2 Present Indian Statistical system: Organisation | Ministry of Statistics and Program Implementation | Government of India (mospi.nic.in)

Unit-II National Sample Survey Office (NSSO) | Ministry of Statistics and Program Implementation | Government of India (mospi.nic.in)

Unit-III National Income: Definition, Concepts and Methods of Measuring National Income (yourarticlelibrary.com)

Unit-IV Census of India - Census Operations (censusindia.gov.in)

Unit-V 2.4 Industrial Statistics | Ministry of Statistics and Program Implementation | Government of India (mospi.nic.in)

INDUSTRIAL VISIT

Course Title: INDUSTRIAL VISIT

Course Code:	Credits : 1
L : 0 T : 0 P : 0 S : 0	CIA Marks :
Exam Hours:	ESE Marks : 100 Marks

Learning Objectives:

1. Demonstrate skills learnt in the real time environment.
2. Explore the different industries that are using Statistical tools and techniques.
3. Enhance the skills in the analytical aspects.
4. Understanding the professional connections with the knowledge learnt.
5. Applying the skills in problem solving.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	To get an insight of an industry and organization/company.
CO2	To gain valuable skills and knowledge.
CO3	To make professional connections and enhance networking.
CO4	To get experience in a field to allow the student to make a career transition.
CO5	To get an inside view of an industry and organization/company.

Components	Marks
Work Diary	25
Report	50
Viva-Voce Examination	25
Total	100

1. Evaluation report and conduct of viva voce will be done jointly by Internal and External Examiners.
2. The passing minimum for this paper 40%.
3. In case, the candidate fails to secure 40% pass minimum, he / she may have to reappear for the same in the subsequent semesters.

SEMESTER IV

CORE COURSE – VI

Course Title: ESTIMATION THEORY

Course Code:	Credits : 4
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. To Emphasize on the Concept of Point Estimation and Interval Estimation.
2. To learn properties of a good estimator.
3. To understand various methods of estimation.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	To know the Point Estimation and its properties.
CO2	To know the MVUE, Cramer- Rao inequality, Rao - Blackwell theorem.
CO3	To know the concept and solving by Methods of Point estimation.
CO4	Analyse the concepts of Method of minimum chi-square and method of least squares.
CO5	To know the concept of Interval Estimation.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	3	3	2	2	2
CO2	3	1	3	3	1	2	1	1	2	3
CO3	1	2	2	2	2	1	2	2	2	2
CO4	2	3	2	3	2	2	3	2	2	1
CO5	2	2	1	2	2	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Point Estimation – Properties of Estimators – Concepts of Unbiasedness, consistency, Efficiency and Sufficiency – Statement of Neyman–Pearson Factorization theorem – Simple Problems.	13	CO1
II	Concepts of Minimum Variance Unbiased Estimator (MVUE) – Cramer-Rao inequality – simple problems, Rao–Blackwell theorem – Lehman Scheffe theorem.	13	CO2
III	Methods of Estimation: Method of Moments and Method of Maximum Likelihood Estimators with their properties – simple problems.	13	CO3
IV	Method of minimum chi-square, Method of Minimum Variance, method of least squares – simple problems.	13	CO4
V	Interval Estimation – Confidence Interval for proportion(s), mean(s), variance and variance ratio based on Normal, Student's t, F and chi square distributions.	13	CO5

Text Book:

1. Mood, AM. Graybill, F.A. and Boes, D.C. (1974): Introduction to the theory of Statistics, McGraw Hill.
2. Hogg R.V. and Craig, A.T. (2002): Introduction to mathematical statistics, 3rd edition, Academic Press, USA.
3. Goon, A.M. Gupta, M.K., and Das Gupta, B. (1980): An outline of statistical theory, Vol.I, 6th revised ed. World Press limited, Calcutta.

Books for Reference:

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

Website Link:

1. https://swayam.gov.in/nd2_cec20_ma01/preview
2. <https://nptel.ac.in/courses/111/104/111104032/>
3. <https://www.polytechnique.edu/elearning/en/catalog/online-course/introductiondistribution-theory>
4. <https://www.coursera.org/courses?query=probability%20distribution>

CORE PRACTICAL II

Course Title: CORE PRACTICAL II – ESTIMATION THEORY

Course Code:	Credits : 2
L : 1 T : 0 P : 2 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 50 Marks

Learning Objectives:

Learn about estimation theory and applied problems practically.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Analyse the concepts of Method of minimum chi-square and method of least squares.
CO2	To know the concept of Interval Estimation.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	3	3	2	2	2
CO2	3	1	3	3	1	2	1	1	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Practical Activities.
Teaching and Learning Methods	Practical with Calculator (Using Scientific Calculator).
Assessment Methods	Observation, Practical Note, Attendance, CIA and ESE.

Course Content

1. Estimation of parameters by the method of moments for Binomial distribution.
2. Estimation of parameters by the method of moments for Poisson distribution.
3. Estimation of parameters by the method of moments for Normal distribution.
4. Estimation of parameters by the method of moments for Exponential distribution.
5. Estimation of parameters by the method of moments for Uniform distribution.
6. Estimation of parameters by the method of moments for Gamma distribution.
7. Estimation of parameters by the method of maximum likelihood for Binomial distribution.
8. Estimation of parameters by the method of maximum likelihood for Poisson distribution.
9. Estimation of parameters by the method of maximum likelihood for Normal distribution.
10. Estimation of parameters by the method of maximum likelihood for Multinomial distribution.
11. Estimation of parameters by the method of maximum likelihood for exponential distribution (Parameter are Unknown).
12. Estimation of parameters by the method of maximum likelihood for exponential distribution (Parameter are known).
13. Confidence interval for population mean in large sample.
14. Confidence interval for difference between two means in large sample.
15. Confidence interval for population proportion in large sample.
16. Confidence interval for difference between two population proportions in large sample.
17. Confidence interval for population mean in small sample.
18. Confidence interval for difference between two means in small sample.
19. Confidence interval for population variance.
20. Confidence interval for the ratio of two population variance.

Text Book:

1. Mood, AM. Graybill, F.A. and Boes, D.C. (1974): Introduction to the theory of Statistics, McGraw Hill.
2. Hogg R.V. and Craig, A.T. (2002): Introduction to mathematical statistics, 3rd edition, Academic Press, USA.
3. Goon, A.M. Gupta, M.K., and Das Gupta, B. (1980): An outline of statistical theory, Vol.I, 6th revised ed. World Press limited, Calcutta.

GENERIC ELECTIVE – IV

Course Title: PYTHON PROGRAMMING

Course Code:	Credits : 3
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. Develop a regular workflow to execute reproducible research and analysis using Python programming.
2. Install and use Python language for specific application.
3. Import data from a variety of external sources
4. Write basic python functions using control and data structures.
5. To know the basic concepts of Python.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Students will able to install, code and use basic Python.
CO2	Describe key terminologies, concepts and techniques employed in statistical analysis.
CO3	Understand how to write simple coding.
CO4	Compile and run the program.
CO5	Interpret the result.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	2	2	1	2	2	3
CO2	2	2	2	2	2	2	2	2	1	3
CO3	2	2	3	2	1	1	2	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Introduction to python – Data types, Variables, Basic Input – Output Operations, Basic Operators.	9	CO1
II	Control statements, if statements, while loop, for loop, infinite loop, nested loop, else suit, break, continue, pass, assert, return statements, command line arguments.	9	CO2
III	Arrays in python, advantages using arrays, creating arrays, importing the array module, indexing and slicing on arrays, Processing the arrays, Comparing arrays. Strings in Python, Creating strings, Length of a string, Indexing in strings, Slicing strings, Concatenation and Comparing Strings.	9	CO3
IV	Functions in Python, Define a function, Calling a function, return from function, pass by object reference, Positional arguments, Default arguments, excursive functions. Introduction to OOP, features of OOP, Creating classes, the self-variable, constructor, types of variables.	9	CO4
V	Inheritance: Define inheritance, types of inheritance, constructors in inheritance, overriding super class constructors & methods, the super () method. Exceptions: Errors in a python program, Exceptions, Exception handling, Type of Exceptions, The Exception block, the assert statement, user defined exceptions.	9	CO5

Text Book:

1. Allen Downey, Jeffrey Elkner, Chris Meyers, How to think like a computer scientist: learning with Python, Freely available online. 2012.
2. NageswaraRao, R, Core Python Programming, 2nd edition, Dreamtech Press, New Delhi (2018).
3. Practical statistics for Data Scientists by Peter Rruce, Andrew Bruce and Peter Gedeck published by Oreilly.

Book for References:

1. Wesley J.Chun, Core Python programming, 2/e, Pearson education (2010).
2. Mark Lutz, Programming Python, 4/e, O'Reilly Media (2010).
3. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd Edition by William McKinney published by oReilly (3 rd Edition will be released by Sep 2022).
4. Hands on matplotlib learn plotting and visualizations with python3 by Ashwin Pajankar published by apress.
5. Haslwanger, T, An Introduction to Statistics with Python with Application in the Life Sciences, Springer, Switzerland (2016).

Website Link:

1. <http://docs.python.org/3/tutorial/index.html>
2. <http://interactivepython.org/courselib/statis/pythononds>
3. <http://www.ibiblio.org/g2swap/byteofpython/read/>

GENERIC ELECTIVE PRACTICAL – II

Course Title: STATISTICAL COMPUTATION USING PYTHON

Course Code:	Credits : 2
L : 1 T : 0 P : 3 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 50 Marks

Learning Outcomes:

Upon finishing this course, students will be able to handle python

1. To understand concept of Matrices and other topics through this Python programming language
2. To do graphical presentation of a data
3. To do Statistical analysis of the data
4. To interpret the data and output of the analysis

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Students will able to install, code and use basic Python.
CO2	Describe key terminologies, concepts and techniques employed in statistical analysis.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	2	2	1	2	2	3
CO2	2	2	2	2	2	2	2	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Practical Activities.
Teaching and Learning Methods	Practical with System (Computer Lab).
Assessment Methods	Observation, Practical Note, Attendance, CIA and ESE.

Course Content:

1. Program to find the Sum of the Series: $1 + x^2/2 + x^3/3 + \dots x^n/n$.
2. Program to check string Manipulation (Counting the no. of vowels, consonants, words, whitespaces in a line of text and array of lines).
3. Program to check a reverse a string & check for palindrome.
4. Program to find Matrix Addition.
5. Program to find Matrix Subtraction.
6. Program to find Matrix Multiplication.
7. Program to find Transpose of a matrix.
8. Program to draw Box Plot, Histogram, Bar Chart, and Pie Chart.
9. Program to calculate the value of Mean, Geometric mean, Harmonic mean, Median and Mode.
10. Program to calculate the value of Range, Interquartile Range, and semi Interquartile Range.
11. Program to find outliers in a dataset using the Interquartile Range method.
12. Program to calculate the value of Variance and Standard Deviation.
13. Program to calculate Skewness and Kurtosis Values.
14. Program to fitting a Binomial distribution.
15. Program to fitting a Poisson distribution.
16. Program to fitting a Normal distribution.
17. Program to calculate Correlation.
18. Program to calculate Regression using scatter plot.
19. Program to draw seasonal (Boxplot of Month-wise) and trend (Year-wise) of a Time Series
20. Program to find additive and multiplicative combination of the base level trend, seasonal index and residual term.

Text Book:

1. Allen Downey, Jeffrey Elkner, Chris Meyers, How to think like a computer scientist: learning with Python, Freely available online. 2012.
2. NageswaraRao, R, Core Python Programming, 2nd edition, Dreamtech Press, New Delhi (2018).
3. Practical statistics for Data Scientists by Peter Rruce, Andrew Bruce and Peter Gedeck published by Oreilly.

DISCIPLINE SPECIFIC ELECTIVE – II (A)

Course Title: OPERATIONS RESEARCH

Course Code:	Credits : 3
L : 2 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. Formulate and solve linear programming problems (LPP)
2. Solve the problems by Transportation and Assignment Procedure.
3. Solve the problems under Replacement Problems.
4. Identify and solve the problems by game theory.
5. Obtain solution to network problems using CPM and PERT techniques.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Solve the linear programming models using various methods
CO2	To solve the problem by transportation and assignment procedure.
CO3	To solve the problem by replacement problem.
CO4	To identify the model and solve the problem by game theory.
CO5	To evaluate the solution to network problems using CPM and PERT.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	2	3	3	2	2	2
CO2	2	2	3	3	1	2	1	1	2	3
CO3	3	3	2	2	2	1	2	2	2	2
CO4	2	3	3	3	2	2	3	2	2	1
CO5	2	2	1	2	2	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Introduction to Operations Research - Nature, Scope, Functions, Linear programming problem - Formulation of LPP - Solving the LPP by graphical method. Solving the LPP by simplex method, Big-M method, Duality in LPP, Dual simplex method and problems.	9	CO1
II	Transportation problem- obtaining initial feasible and optimal solutions. Optimality test, degeneracy, Unbalanced transportation problem, Assignment problem, and unbalanced assignment problem - Traveling salesman problem.	9	CO2
III	Replacement Problems- Replacement of items that deteriorate with time- Replacement age of a machine taking money value into consideration- Replacement of items that fail completely- Mortality and staffing attributes.	9	CO3
IV	Game Theory - Two person zero sum games, The maximin - minimax principle – Games without saddle points - Mixed strategies - Graphical solution of 2xn and mx2 games Dominance property. Sequencing - 'n' jobs through 2 machines - 'n' jobs through 3 machines - 'n' jobs through 'm' machines, Two jobs and 'm' machines.	9	CO4
V	Network analysis by CPM / PERT basic concepts - constraints in Network – construction of the network - Time calculations - Concepts of slack and float in Network Analysis -finding optimum project duration and minimum project cost, finding expected project time and variance.	9	CO5

Text Book:

1. Kanti Swaroop, Gupta. P.K. and Manmohan: Operations Research, Sultan Chand and Sons, New Delhi.
2. Sharma J.K. (2001): Operations Research. Theory and applications, Macmillan India Ltd.
3. Hamdy A. Taha (1996): Operations Research, 6 ed. Prentice Hall of India.

Books for Reference:

1. Goel & Mittal (1982): Operations Research, Pragati Prakashan, Meerut.
2. Gupta R.K. (1985): Operations Research, Krishna Prakashan, Mandir, Meerut. Schaum's outline series: Operations Research.
3. Sharma J.K. (2002): Operations Research, Problems and Solutions, Macmillan India Ltd.

Website Link:

1. <https://nptel.ac.in/courses/111/107/111107128/>
2. <https://nptel.ac.in/courses/112/106/112106134/>
3. https://onlinecourses.swayam2.ac.in/cec20_ma10/preview

DISCIPLINE SPECIFIC ELECTIVE – II (B)

Course Title: BIOSTATISTICS

Course Code:	Credits : 3
L : 2 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. Initiate the awareness of Biostatistics and its need.
2. Make the students have a clear understanding of special kinds of various statistical tools used in biostatistics.
3. Be knowledgeable about the potential applications of these tools.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Understand the concepts and statistical tools used in Biostatistics.
CO2	Effectively apply these tools on solving the biological problems occurring in real life.
CO3	Analyse the given Bio-statistical data as per the objectives of the problem.
CO4	Interpret the outcomes of the analyses meaningfully.
CO5	Create research problems of his own and able to proceed with them.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	2	3	3	2	2	2
CO2	2	2	3	3	1	2	1	1	2	3
CO3	3	3	2	2	2	1	2	2	2	2
CO4	2	3	3	3	2	2	3	2	2	1
CO5	2	2	1	2	2	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Introduction to Bio statistics – Various types of studies – Ethics – Measures of disease frequency and disease burden. Clinical trials – Goals of Clinical trials – Phases of clinical trials – Classification of clinical trials.	9	CO1
II	Randomization: Fixed Allocation, Simple, Blocked, Stratified, Baseline Adaptive and Response Adaptive – Blinding: Single, Double and triple- Designs for clinical Trials: Parallel Groups Design, Cluster Randomization Designs and Crossover Designs.	9	CO2
III	Multiple Regression – Assumptions – Uses – Estimation and interpretation of regression coefficients – Testing the regression coefficients – Coefficient of determination.	9	CO3
IV	Logistic Regression: Introduction – Logistic regression model – Relative risk – Logit – odds Ratio – Properties of odds ratio – the relationship between the odds ratio and relative risk.	9	CO4
V	Maximum likelihood estimates and interpretation of coefficients – Test for coefficients – Test for overall regression and goodness of fit using Maximum Likelihood technique – Deviance Statistics , Wald Test, LR Test and score test.	9	CO5

Text Book:

1. Chow, S. C., and Liu, J. P. (2013). Design and Analysis of Clinical Trials: Concepts and Methodologies, Third Edition, Wiley – Interscience, John Wiley & Sons, NJ.
2. Friedman, I. M., Furberg, C. D., and DeMets, D. L. (2015), Fundamentals of Clinical Trials, Fifth edition, Springer – Verlag, NY

Books for Reference:

1. Van Belle, G., Fisher, L. D., Heagerty, P. J., and Lumley, T. (2004). Bio-Statistics – A Methodology for the Health Science, Second Edition, Wiley, NY.
2. Daniel, W. W. and Chad L. Cross (2018). Bio-Statistics: A foundation for analysis in the Health Sciences, Eleventh Edition, John Wiley & Sons, NY.
3. Kleinbaum, D. G., and Klein, M. (2012): Logistic regression: A Self-Learning Text, Third Edition, Springer – Verlag, NY.
4. Hosmer, Jr. D. W., Lemeshow, S., and Sturdivant, R. X. (2013). Applied Logistic Regression, Third Edition, John Wiley & Sons, Inc., NY.
5. Rossi, R. J. (2010). Applied Biostatistics for Health Sciences, John Wiley & Sons, Inc., NY

Website Link:

1. https://97wayam.gov.in/nd1_noc20_bt28/preview
2. https://97wayam.gov.in/nd2_cec20_ma05/preview

DISCIPLINE SPECIFIC ELECTIVE – II (C)

Course Title: RDBMS WITH SQL FOR DATA ANALYSIS

Course Code:	Credits : 3
L : 2 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning objectives:

1. To understand the different issues involved in the design and implementation of a database system.
2. To study the physical and logical database designs, database modelling, relational, hierarchical, and network models.
3. To understand and use data manipulation language to query, update, and manage a database.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	To demonstrate the characteristics of Database Management Systems. To study about the concepts and models of database. To impart the concepts of System Development Life Cycle and E-R Model.
CO2	To classify the keys and the concepts of Relational Algebra. To impart the applications of various Normal Forms Classification of Dependency.
CO3	To elaborate the different types of Functions and Joins and their applications. Introduction of Views, Sequence, Index and Procedure.
CO4	Representation of PL-SQL Structure. To impart the knowledge of Sub Programs, Functions and Procedures.
CO5	Representation of Exception and Pre-Defined Exception. To Point out the Importance of Triggers, Implicit and Explicit Cursors.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3	3	3	3	3	3
CO2	2	2	2	2	2	3	3	3	2	3
CO3	3	2	2	2	1	3	3	3	3	3
CO4	2	3	3	3	2	2	3	3	3	3
CO5	2	2	1	2	2	3	3	3	3	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Purpose of Database Systems – Views of data – Data models – Database Language - Relational databases Systems – Architecture of Database Management Systems - System Development Life Cycle – Entity Relationship Model.	9	CO1
II	Relational Database Model: Structure of Relational Model – Types of keys. Relational Algebra: Unary operations – Set operations – Join operations. Normalization: Functional Dependency – First Normal form – Second Normal Form – Third Normal form – Boyce-Codd Normal Form – Fourth Normal Form.	9	CO2
III	SQL: Introduction. Data Definition Language: Create, alter, drop, rename and truncate statements. Data Manipulation Language: Insert, Update and Delete Statements. Data Retrieval Language: Select statement, Distinct function, concatenation function, arithmetic operations.	9	CO3
IV	Built in functions: Single row functions and Group functions: count, max, min, avg and sum functions. Set Functions: Union, union all, intersect and minus. Sub query: Single row sub query, Multiple row sub query and Correlated sub query. Joins: Inner and Outer joins. Views, Object views – Synonyms – sequence and Index.	9	CO4
V	Introduction to PL / SQL – Fundamentals of PL / SQL – Block Structure – Data Types – Control Structures – Procedure and Functions – Packages – Triggers.	9	CO5

Text Book:

1. Abraham Silberschatz, Henry Korth, S. Sudarshan, “Database System Concepts”, Seventh Edition, TMH.
2. Ivan Bayross, “SQL, PL/SQL the Programming Language of Oracle”, BPB Publication.

Books for References:

1. Pranab Kumar Das Gupta and P. Radha Krishnan, “Database Management System Oracle SQL and PL/SQL”, Second Edition, 2013, PHI Learning Private Limited.
2. RamezElmasri and Shamkant B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Publications.

Web Resources

1. <https://www.futurelearn.com/courses/introduction-to-databases-and-sql>
2. <https://alison.com/courses/diploma-in-databases-and-t-sql-revised/content>
3. https://onlinecourses.nptel.ac.in/noc20_cs60/preview

SEMESTER V

CORE COURSE – VII

Course Title: TESTING OF HYPOTHESIS

Course Code:	Credits : 4
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. To know the concepts of Testing of hypothesis.
2. To analysis the concepts of uniformly most powerful tests and Non-Parametric tests.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	To know the concept of Testing of Hypothesis.
CO2	To know the concept of Testing of significance: Exact test based on large sample test.
CO3	To know the concept of Testing of significance: small sample test, F and Chi square test.
CO4	Analyse the Uniformly most powerful tests, Likelihood ratiocriterion - Definition and test for means and variance.
CO5	Understand the concept of non-parametric test - Applications and simple problems.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3	3	3	1	2	1
CO2	1	2	3	3	2	1	2	2	2	3
CO3	3	2	2	2	2	2	1	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Testing of Hypothesis – Neymann – Pearson theory – Statistical Hypothesis – Simple and composite hypothesis, Null and Alternative Hypothesis – Two types of errors – critical region – power of a test - Most powerful test – Neyman-Pearson lemma.	13	CO1
II	Test of significance – Large Sample Tests: Test of significance for large samples, Tests for Single proportion, mean and standard deviation, Difference of proportions, means and standard deviations – Problems.	13	CO2
III	Small Sample Tests: t-tests: Assumptions, Test for single mean, Two means, Paired sample test and Correlation coefficient. Chi-square tests: Uses, Tests for single variance, independence of attributes and Goodness of fit. F-test for equality of two variances.	13	CO3
IV	Uniformly most powerful tests – Likelihood ratio criterion – Definition and test for means and variance (one sample only).	13	CO4
V	Non-parametric tests – definition – advantages and disadvantages – Run test, Sign test, Wilcoxon Signed rank test, Median test – Mann Whitney tests (one sample and two samples), Kruskal Wallis test – Applications and simple problems.	13	CO5

Text Book:

1. Hogg R.V. and Craig, A.T. (2002): Introduction to mathematical statistics, 3rd edition, Academic Press, USA.
2. Goon, A.M. Gupta, M.K., and Das Gupta, B. (1980): An outline of statistical theory, Vol.I, 6th revised ed. World Press limited, Calcutta.
3. Rohatgi, V.K. (1984): An introduction to probability theory and mathematical statistics, Wiley Eastern.

Books for Reference:

1. Mood, A.M. Graybill, F.A. and Boes, D.C. (1974): Introduction to the theory of Statistics, McGraw Hill.
2. Hod, P.G. (1971): Introduction to mathematical statistics, Asia publishing house.
3. Marek Fisz (1961): Probability theory and Mathematical statistics, John Wiley.
4. Spiegel, M.R. (1982): Theory and problems of probability and statistics, Schaum's outline series, McGraw Hill.
5. Snedecor, G.W. and Cochran, W.G. (1967): Statistical methods 6th edition.

Website Link:

1. https://www.sci.utah.edu/~arpaiva/classes/UT_ece3530/hypothesis_testing.pdf
2. [https://stats.libretexts.org/Bookshelves/Introductory_statistics/Book%3A_Introductory_Statistics_\(Shafer_and_Zhang\)/08%3A_Testing_Hypotheses/8.2%3A_Large_Sample_Tests_for_a_Population](https://stats.libretexts.org/Bookshelves/Introductory_statistics/Book%3A_Introductory_Statistics_(Shafer_and_Zhang)/08%3A_Testing_Hypotheses/8.2%3A_Large_Sample_Tests_for_a_Population)
3. <https://www.itl.nist.gov/div898/handbook/apr/section2/apr233.htm>

CORE COURSE – VIII

Course Title: SAMPLING THEORY

Course Code:	Credits : 4
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. To impart the knowledge of planning of sample survey.
2. Understand the concept of random sampling, determine sample size, method of Stratification and systematic sampling

Course Outcomes: At the end of the Course, the Student will be able to

CO1	To study various steps involved in planning of sample survey.
CO2	To obtain sample estimates and to study their properties for simple random sampling.
CO3	To identify sample estimates for the method of stratification.
CO4	To find sample estimates and to study their properties for systematic sampling.
CO5	To identify sample estimates for PPS sampling.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	2	3	1	3	1	2	2
CO2	2	2	3	3	2	2	2	2	3	3
CO3	3	3	2	2	2	2	1	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Design – Organization and execution of sample surveys – principle steps in sample survey – Pilot survey – principles of sample survey – sampling and non-sampling errors – advantages of sampling over census – limitations of sampling.	13	CO1
II	Sampling from finite population – simple random sampling with and without replacement – unbiased estimate of the mean, variance of the estimate of the mean - determination of sample size.	13	CO2
III	Stratified random sampling – properties of the estimates – unbiased estimates of the mean and variance of the estimates of the mean – optimum and proportional allocations – relative precision of a stratified sampling and simple random sampling	13	CO3
IV	Systematic sampling – methods of systematic sampling: Linear, circular of systematic sampling, properties and limitations of systematic sampling – Estimate of mean and variance of the estimated mean – comparison of simple and stratified with systematic random sampling – $\text{var}(\bar{X}_{st}) \leq \text{var}(\bar{X}_{sys}) \leq \text{var}(\bar{X}_{srsWOR})$	13	CO4
V	Varying Probability Sampling: PPS selection – cumulative total method – Lahiri's method – estimation in PPS sampling with replacement total and its sampling variance.	13	CO5

Text Book:

1. William, G. Cochran (1984): Sampling techniques, Wiley Eastern.
2. Murthy, M.N. (1967): Sampling theory and methods, Statistical Publishing Society, Calcutta.
3. Sampath S. (2005): Sampling theory and methods (2nd Edition). Alphascience International Ltd.

Books for Reference:

1. Des Raj and Khanis (1976): Sampling theory, Narosha Publications,
2. Daroga Singh and Chaudhary, F.S. (1986): Theory and Analysis of Sample Survey Designs. Wiley Eastern.
3. Sukhatme P.V. and Sukhatme B.V. (1984): Sample survey methods and its applications, Indian Society of Agricultural Statistics, New Delhi.

Website Link:

1. https://course-notes.org/statistics/sampling_theory
2. <https://www.statstutor.ac.uk/resources/uploaded/13samplingtechniques.pdf>
3. https://www.ph.ucla.edu/epi/rapidsurveys/RScourse/RSbook_ch3.pdf
4. https://www.investopedia.com/terms/stratified_random_sampling.asp
5. https://conflict.lshtm.ac.uk/page_35.htm

CORE COURSE – IX

Course Title: **RELIABILITY AND SURVIVAL ANALYSIS**

Course Code:	Credits : 4
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning objectives:

1. The objective of this course is to provide the appropriate of statistics in handling survival data.
2. This course introduces the concept of censoring and various life time distributions used to analyse such data.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Analyse survival data and interpret results using parametric regression models.
CO2	Compute sample size for survival analysis study.
CO3	Assess models for fulfilment to proportional hazards and other aspects of model.
CO4	Estimation of survival functions.
CO5	Understand Cox proportional hazards regression models.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	2	2	1	2	2	3
CO2	2	2	2	2	2	2	2	2	1	3
CO3	2	2	3	2	1	1	2	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Introduction to Survival concepts, Survival functions and hazard rates, concepts of Type – I, Type II errors. Random and other types of censoring, likelihood in these cases.	13	CO1
II	Life distributions- Exponential, Weibull, Gamma, Lognormal, Pareto distribution.	13	CO2
III	Linear failure rate, estimation / testing under censoring setup. Life tables, failure rate, mean residual life and their elementary properties.	13	CO3
IV	Estimation of Survival functions – actuarial estimator, Product – limit (Kaplan-Meier) estimator, properties.	13	CO4
V	Cox proportional hazards regression models with one and several covariates, Exponential, Weibull, Lognormal regression.	13	CO5

Text Book:

1. Miller, R.G. (1981): Survival analysis, John Wiley.
2. Cox, D.R and Oakes, D. (1984): Analysis of Survival data, Chapman & Hall, New York.

Books for Reference:

1. Griss, A. J. and Clark, V. A (1975): Survival distribution: Reliability applications in the Biomedical sciences, John Wiley and Sons.
2. Elandt-Johnson, R .E. Johnson, N. L.: Survival models and data analysis, John Wiley & sons.
3. Kalbfleish, J. D. and Prentice R. L (1980): The Statistical analysis of failure time data, John Wiley.

Website Link:

1. <http://www.sph.emory.edu/dklein/surv3.htm>
2. <https://onlinelibrary.wiley.com/doi/10.1002/bimj.4710290119>
3. <https://www.wiley.com/en-us/Survival+Models+and+Data+Analysis-p-9780471031741>

CORE COURSE – X

Course Title: **R PROGRAMMING**

Course Code:	Credits : 4
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. Develop a regular workflow to execute reproducible research and analysis using R and R Studio and communicate the results and implications to others.
2. Install and use R packages for specific applications.
3. Import data from a variety of external sources.
4. Write basic R functions using control and data structures.
5. Employ R functions to conduct statistical analysis and inference.
6. Generate research or analytical reports and presentations using R Markdown.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Students will able to install, code and use basic R programming.
CO2	Describe key terminologies, concepts and techniques employed in statistical analysis.
CO3	Understand how to write simple coding.
CO4	Compile and run the program.
CO5	Interpret the result.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	2	2	1	2	2	3
CO2	2	2	2	2	2	2	2	2	1	3
CO3	2	2	3	2	1	1	2	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Installation of R – Features of R –Variables in R-Constants in R – Operators in R. Creating data frame – Operations on data frames – Accessing data frames - Creating data frames from various sources. Creating lists – Manipulating list elements – Merging lists.	13	CO1
II	Data types and R Objects – Accepting Input from keyboard – Important Built-in functions. Creating Vectors – Accessing elements of a Vector – Operations on Vectors – Vector Arithmetic – Converting lists to vectors. Creating arrays – Accessing array elements – Calculations across array elements.	13	CO2
III	Creating matrices – Accessing elements of a Matrix – Operations on Matrices –Matrix transpose. R Programming Structures, Control Statements, Loops – Looping Over Non vector Sets – if...else statement – if else() function – switch() function –repeat loop – while loop – for loop – break statement – next statement.	13	CO3
IV	Need for data visualization – Bar plot – Plotting categorical data – Stacked bar plot – Histogram – plot() function and line plot – pie chart / 3D pie chart – Scatter plot –Box plot – Customizing Graphs, Saving Graphs to Files.	13	CO4
V	Probability Distributions – Binomial Distribution – Poisson Distributions, Normal Distribution. Correlation – Regression. Chi-Square test. T-Test – Non- Parametric Tests.	13	CO5

Text Book:

1. Michale J. Crawley, Statistics: An Introduction using R, John Wiley & Sons, England (2015).
2. William N. Venables and David M. Smith, An Introduction to R. 2nd Edition. Network Theory Limited. 2009.
3. Norman Matloff, The Art of R Programming –A Tour of Statistical Software Design, No Starch Press. 2011.
4. Sudha G. Purohit et.al. Statistics Using R, Narosa Publishing House, India (2008).

Books for References:

1. John Verzani, simple R-Using R for Introductory Statistics, (<http://www.math.csi.cuny.edu/Statistics/R/SimpleR/Simple.>)
2. W. N. Venables, D. M. Smith and the R Core Team, An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics, Version 2.15.2 (2012-10-26).
3. Andrew Oleksy (2018), Data Science with R – A Step by Step with Visual Illustration and Examples.

Website Link:

1. <https://cran.r-project.org/doc/contrib/Owen-TheRGuide.pdf>
2. <https://sphweb.bumc.bu.edu/otlt/MPH-Modules?BS/R/R-Manual/R-Manual2.html>
3. <https://smac-group.github.io/ds/>

CORE PRACTICAL III

Course Title: **CORE PRACTICAL III – TESTING OF HYPOTHESIS AND SAMPLING THEORY**

Course Code:	Credits : 2
L : 1 T : 0 P : 3 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 50 Marks

Learning Objectives:

Upon finishing this course, students will be able to

1. Learn about non-parametric tests and applied problems practically.
2. Apply concept of simple random sampling, stratified random sampling and systematic random sampling.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	To know the concept of Testing of Hypothesis.
CO2	To study various steps involved in planning of sampling methods.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3	3	3	1	2	1
CO2	1	2	3	3	2	1	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Practical Activities.
Teaching and Learning Methods	Practical with Calculator (Using Scientific Calculator).
Assessment Methods	Observation, Practical Note, Attendance, CIA and ESE.

Course Content:

I Test of Hypothesis

1. Estimating the Power of the test and level of significance using Binomial distribution.
2. Estimating the Power of the test and level of significance using Poisson distribution.
3. Estimating the most powerful test.

II Test of Significance: Large Sample

4. Testing for a single mean
5. Testing for difference between two Population mean
6. Testing for single population proportion.
7. Testing for difference between for two population proportion.
8. Testing for a single standard deviation.
9. Testing for difference between two sample standard deviation.

III Test of Significance: Small Sample

10. Testing for a single mean
11. Testing for difference between two Population mean
12. Testing of Paired observation
13. Chi-square test for single variance
14. Chi-square test for independence of attributes
15. Chi-square test for goodness of fit
16. F test for equality of two variances

IV Non-parametric methods

17. Run test
18. Sign test
19. Wilcoxon Signed rank test
20. Median test
21. Kruskal Wallis test

V Sampling Theory

22. Simple Random Sampling with replacement.
23. Simple Random Sampling without replacement.
24. Stratified Random Sampling- Proportional Allocation.
25. Stratified Random Sampling- Optimum Allocation.
26. Systematic Sampling.

Text Book:

1. Gupta S.P. & Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 12th Edition 2020.
2. Parimal Mukhopadhyay, (1996), Mathematical Statistics, New Central Book Agency.
3. William, G. Cochran (1984): Sampling techniques, Wiley Eastern.

CORE PRACTICAL IV

Course Title: **CORE PRACTICAL IV – STATISTICAL DATA ANALYSIS USING R PROGRAMMING**

Course Code:	Credits : 2
L : 1 T : 0 P : 3 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 50 Marks

Learning Objectives:

Upon finishing this course, students will be able to handle R

1. Knowledge about R and its basic operations-creating a vector, importing data, saving output and graphics using R.
2. Ability to represent data diagrammatically and graphically, compute correlation, regression and to fit discrete and continuous distributions using R.
3. Analyse the data using testing for proportions and means, Able to carry out chi square test and non-parametric tests.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Students will able to install, code and use basic R programming.
CO2	Describe key terminologies, concepts and techniques employed in statistical analysis.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	2	2	1	2	2	3
CO2	2	2	2	2	2	2	2	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Practical Activities.
Teaching and Learning Methods	Practical with System (Computer Lab).
Assessment Methods	Observation, Practical Note, Attendance, CIA and ESE.

Course Content:

1. Write an R program to create a list of elements using Vector and its operations.
2. Write an R program to create a list of elements using Matrix operations (Addition, Subtraction, multiplication, transpose, rank, inverse and determination of a matrix).
3. Write an R program to create a diagrams (Simple and multiple bar diagrams).
4. Write an R program to create a Box-whisker plot.
5. Write an R program to create a Histogram using single group and multiple groups.
6. Write an R program to find Measures of central tendency (Raw data).
7. Write an R program to find Measures of central tendency (Discrete data).
8. Write an R program to find Measures of central tendency (Continuous data).
9. Write an R program to find Measures of dispersion (Raw data).
10. Write an R program to find Measures of dispersion (Discrete data).
11. Write an R program to find Measures of dispersion (Continuous data).
12. Write an R program to find Measures of Skewness (Discrete data).
13. Write an R program to find Measures of Skewness (Continuous data).
14. Write an R program to find Measures of Kurtosis (Discrete data).
15. Write an R program to find Measures of Kurtosis (Continuous data).
16. Write an R program to find Correlation and Regression.
17. Write an R program to Generating random samples (Binomial, Poisson and Normal).
18. Write an R program for Fitting of Binomial, Poisson and Normal distributions.
19. Write an R program to find Confidence interval for proportion.
20. Write an R program to find simple random sampling (with and without sampling).
21. Write an R program to find stratified random sampling.
22. Write an R program to find systematic random sampling.

Text Book:

1. Michale J. Crawley, Statistics: An Introduction using R, John Wiley & Sons, England (2015).
2. William N. Venables and David M. Smith, An Introduction to R. 2nd Edition. Network Theory Limited. 2009.
3. Sudha G. Purohit et.al. Statistics Using R, Narosa Publishing House, India (2008).

INTERNSHIP

Course Title: INTERNSHIP

Course Code:	Credits : 2
L : 0 T : 0 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 50 Marks

Learning Objectives:

1. An internship offers a large number of benefits to young minds who want to expand their horizon.
2. It enables them to get their job easily.
3. It also offers a platform to know their potential and a sense of confidence.
4. An internship helps them to equip their domain knowledge with analytical intelligence.
5. It is highly useful for interns who train their minds.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Apply new techniques and ideas in the analysis filed of statistics.
CO2	Analyse the results of new initiatives.
CO3	Create a new work plan with greater output.
CO4	Create a framework of work execution ideas.
CO5	Create a detailed technical work plan and terminologies to be followed in the industry.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	2	3	2	3
CO2	2	3	3	2	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	2	3	2	3	3	3	3	3	3	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	
Teaching and Learning Methods	
Assessment Methods	CIA: Highly Commended. 1. Notes and Training Report / Viva-voce.

1. The students should undergo 15 days of internship training any individual students have to identify the Intuition / Industry / University of their choice during the vacation which falls at the end of the fourth semester.
2. The training bridges the gap between the theoretical knowledge gained in college and the practical application of the same in the industry / company / stores. The student will have a better exposure about the workplace and its nuances.
3. Schedule of visit to made by the staff is to be prepared by the HOD / Staff-in-charge.
4. The trainees should strictly adhere to the rules and regulations and office timings of the institutions to which they are attached.
5. A staff member of a department (Guide) will be monitoring the performance of the candidate.
6. The students should maintain notes where the student should record his details of the training.
7. The trainees have to obtain a certificate on successful completion of the internship from the chief executive of an organization.
8. The students should submit an attendance certificate to the institution for 15 days internship training from an organization.
9. Internship Training Report (30 – 50 Pages) should be prepared by the student and submitted in a month's time and end of the semester student should present the report with power point presentation.
10. Industrial training reports shall be prepared by the students under the supervision of the faculty of the department.
11. Industrial training report must contain the following:
Cover page copy of training certificate, profile of an industry report about the work undertaken by them during the tenure of training observation about the concern findings.
12. Practical Viva-Voce examination will be conducted with Internal & External Examiners at the end of the 5th Semester. The internship result will be declared in the fifth semester mark sheet. The internship programme does not carry any marks. The mark sheet will be showing the report of the external examiner after the viva-voce examination as Commended or Highly Commended.

SEMESTER VI

CORE COURSE – XI

Course Title: DESIGN OF EXPERIMENTS

Course Code:	Credits : 4
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. To impart the knowledge of principles of experimental design, one way and Two-way ANOVA
2. To discover the knowledge of applications of CRD, RBD and LSD and factorial experiments and their analysis.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Know the basic principles of experimental design.
CO2	Understand the classification of one way and two-way analysis.
CO3	Understand the applications of CRD, RBD and LSD.
CO4	Know the missing plot technique of RBD, LSD, ANOVA and ANOCOVA.
CO5	Know the factorial experiment and obtain the importance of design of experiments.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3	2	3	2	2	2
CO2	2	2	2	2	2	1	2	2	3	3
CO3	2	2	2	2	1	2	2	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Fundamental Principles of Experiments – Replication, Randomization and Local Control Techniques – Size of experimental unit – Methods of determination of experimental units – Basic Linear model and its assumptions.	13	CO1
II	Analysis of Variance – one-way, two-way classification (without interaction) Multiple range tests: Newman Keul's test – Duncan's multiple range test – Tukey's test.	13	CO2
III	Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) and its analysis.	13	CO3
IV	Missing plot technique – Estimating missing observation RBD with one or two missing observations and LSD with one missing observation – Analysis of covariance in CRD with single covariate, difference between ANOVA and ANOCOVA.	13	CO4
V	Factorial experiments and their need, 2^2 , 2^3 and 2^k factorial experiments and their analysis – Principles of confounding (Concept Only).	13	CO5

Text Book:

1. Dass M.N and Giri N.C (1986) Design and Analysis of Experiments, Wiley Eastern, New Delhi.
2. Montgomery, D (1972) Design and Analysis of Experiments, John Wiley and Sons

Books for Reference:

1. Kempthorne, (1956) Design and Analysis of Experiments, John Wiley. New York
2. Giri N.C (1986) Analysis of Variance, South Asian publishers.
3. Parimal Mukhopadhyay, (1999), Applied Statistics, New Central Book Agency Pvt Ltd, Kolkata.

Website Link:

1. <https://www.biostat.wisc.edu/~kbroman/teaching/stat371/notes03.pdf>
2. <https://egyankosh.ac.in/bitstream/123456789/11670/1/Unit-8.pdf>
3. <https://www.msuniv.ac.in/Download/Pdf/87ac70792d404c3>
4. <https://home.iitk.ac.in/~shalab/anova/chapter8-anova-factorial-experiment.pdf>
5. <http://home.iitk.ac.in/~shalab/anova/chapter6-anova-bibd.pdf>

CORE COURSE – XII

Course Title: STATISTICAL QUALITY CONTROL

Course Code:	Credits : 4
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning objectives:

1. To enable the students to understand the concept of quality, process and product control using control chart techniques and sampling inspection plan.
2. To have an idea about quality management, quality of conformance, quality movement and standardization of quality.
3. To learn the principle of acceptance sampling, single, double, multiple and sequential sampling plan.
4. To reduce the number of rejects and save the cost of material.
5. To apply various sampling plans in industrial environment to study, analyse and control the quality of products.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Understand the general theory of Control charts.
CO2	Know the variable control charts and attribute control charts.
CO3	Obtain the basic concept of acceptance sampling plan and OC Curve.
CO4	Obtain the acceptance sampling by attributes.
CO5	Know the Sequential sampling plan.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3	1	3	1	2	2
CO2	2	2	2	2	2	1	2	2	3	3
CO3	1	2	2	2	1	2	1	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	2	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Quality – Meaning – Concepts – Quality of design – Quality of Conformance – Quality of performance. Statistical Quality Control – Meaning – Basic concepts of SQC – Uses – Causes of Quality variation – Use of the Shewhart control chart – Specification and tolerance limits – 3 sigma limits – warning limits – Need for Statistical Quality Control techniques in Industry.	13	CO1
II	Control chart – Control charts for variables - $\bar{X}$ chart, R chart, σ chart – Plotting and interpretation of $\bar{X}$ and R control charts. Control chart for attributes – purpose of the chart – p chart – np chart – construction of p and np chart – construction of c chart (for fixed and varying sample size) – Comparison of attribute and variable control charts – Modified control limits.	13	CO2
III	Product Control - Acceptance of sampling plans for attributes - Definitions of AQL, RQL, LTPD, AOQL, ASN, ATI, Producer's risk and consumer's risk – Rectifying Inspection plan – Concept of OC function – Type A and Type B OC curves – OC Functions Based on Hyper-geometric, Binomial and Poisson distributions - Attribute Sampling Plans – Designing a Sampling Plan.	13	CO3
IV	Single Sampling Plan - Designing a Sampling Plan - Determination of the parameters in Single Sampling Plans - OC, AOQ, ASN and ATI functions of SSP. Double Sampling Plan - Operating Procedures - Conditions of Applications - OC, AOQ, ASN and ATI functions – Advantages and Disadvantages. Multiple Sampling Plan – Definition and Operating Procedures.	13	CO4
V	Sequential sampling plan for Attributes: Definition – Advantages – Sequential Probability Ratio Test – OC and ASN functions – Five points on OC and ASN curve.	13	CO5

Text Book:

1. Gupta S. C. and Kapoor V. K (2015): Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.
2. Gupta, R.C. (1974): Statistical Quality Control.
3. Montgomery, D.C. (1983): Introduction to Statistical Quality Control, John Wiley & Sons.

Books for Reference:

1. Mahajan. M (2009): Statistical Quality Control, Dhanpat Rai & Co (P) Ltd, Delhi.
2. Grant, E. L. and Laven Worth, R.S.: Statistical Quality Control, McGraw Hill.
3. Edward G. Schilling and Dean V. Neubauer (2009) Acceptance sampling in Quality Control, 2nd edition, (Statistics: A series of Textbooks and Monographs) hard cover – March 2, 2009. Chapman and hall/ CRC.
4. Parimal Mukhopadhyay (1999), Applied Statistics, New Central Book Agency Pvt Ltd, Kolkata.

Website Link:

1. http://bmepedia.weebly.com/uploads/2/6/6/8/26683759/unit_4_quality_control.pdf
2. <https://nptel.ac.in/courses/116/102/116102019/>

CORE COURSE – XIII

Course Title: REGRESSION ANALYSIS

Course Code:	Credits : 4
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning objectives:

1. To develop a deeper understanding of the linear and non-linear regression model and its limitations.
2. To learn how to develop regression model and apply for the specific perspective data appropriate manner.
3. Regression analysis is the most common statistical modelling approach used in data analysis and it is the basis for advanced statistical modelling.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Understand multiple linear regression models with applications. Apply simple linear regression model to real life examples.
CO2	Apply Multiple linear regression models and its implementation in real life situation.
CO3	Understand the concept and real life applications of Multicollinearity and autocorrelation.
CO4	Gaining the knowledge for generalized and weighted least squares and Robust regression models.
CO5	Develop a deeper understanding of the linear regression model and validation of regression models.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3
CO3	3	3	3	3	3	2	3	2	3	2
CO4	3	3	3	2	3	3	3	3	2	3
CO5	3	3	2	3	2	3	3	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Simple regression models with one independent variable, assumptions, estimation of parameters, standard error of estimator, testing the significance of regression coefficients, standard error of prediction.	13	CO1
II	Fitting of straight line by matrix method (General Linear model), Analysis of variance, and General linear hypothesis testing in regression situation weighted least squares bias in regression estimates.	13	CO2
III	Multiple regression analysis: Estimation of parameters. Partial regression coefficient. OLS and ML estimation.	13	CO3
IV	Multiple regression analysis: Hypothesis testing about individual regression coefficients, testing the overall significance of the sample regression, testing the equality of two regression coefficients, prediction with multiple regression.	13	CO4
V	Selection of variables in regression. Forward, backward and optimum method, Evaluation criteria (R^2 , adjusted R^2).	13	CO5

Text Book:

1. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2003): Introduction to Linear regression analysis, third edition, John Wiley and Sons, Inc.
2. Douglas C. Montgomery (2012): Introduction to Linear Regression Analysis.

Book for Reference:

1. Darper, N.R. and Smith, H. (2003): Applied Regression Analysis, third edition, John Wiley and Sons, Inc.
2. Johnston, J. (1984): Econometric methods, third edition, McGraw Hill International.
3. Iain Pardoe (2012): Applied regression Modeling, second edition, Wiley.
4. A. Sen, M. Srivastava, Regression Analysis – Theory, Methods, and Applications, Springer-Verlag, Berlin, 2011.

Web Resources

1. <http://home.iit.ac.in/shalab/regression/> Chapter 2- Regression Simple linear Regression Analysis, pdf
2. <http://www.mit.edu/6.s085/notes/lecture3.pdf>
3. https://ncss-wpengine.netdna-ssl.com/wp-content/themes/ncss/pdf/procedures/NCSS/Nonlinear_Regression.pdf
4. <https://data.princeton.edu/wws509/notes/c4.pdf>
5. <http://home.iiitk.ac.in/shalab/regression/Chapter15-Regression-Poisson> Regression Models.pdf

CORE PRACTICAL – V

Course Title: CORE PRACTICAL V – DESIGN OF EXPERIMENTS AND STATISTICAL QUALITY CONTROL

Course Code:	Credits : 2
L : 1 T : 0 P : 3 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 50 Marks

Learning Objectives:

1. To use appropriate experimental designs to analyze the experimental data.
2. To understand the concepts of Analysis of Variance and Factorial experiments practically.
3. Applying the concept of process control charts and product control OC curve.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Understand the applications of one way, two-way analysis, CRD, RBD and LSD.
CO2	Understand the applications of process and product control charts.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	3	2	3	2	2	2
CO2	2	2	2	2	2	1	2	2	3	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Practical Activities.
Teaching and Learning Methods	Practical with Calculator (Using Scientific Calculator).
Assessment Methods	Observation, Practical Note, Attendance, CIA and ESE.

Course Content:

I Design of Experiments

1. Analysis of Variance - one-way classification with equal number of observations.
2. Analysis of Variance - one-way classification with unequal number of observations.
3. Analysis of Variance - one-way classification with coding method.
4. Analysis of Variance - two-way classification.
5. Analysis of Completely Randomized Design.
6. Analysis of Randomized Block Design.
7. Analysis of Latin Square Design.
8. One missing observation in RBD.
9. Two missing observation in RBD.
10. One missing observation in LSD.
11. Analysis of 2^2 Factorial experiments.
12. Analysis of 2^3 Factorial experiments.

II Statistical Quality Control

13. Construct X-bar Chart and R Chart.
14. Construct X-bar Chart and σ chart.
15. Construct X-bar chart, R Chart and σ chart.
16. Construct p chart for fixed sample size.
17. Construct p chart for unequal sample size.
18. Construct np chart.
19. Construct c chart for fixed sample size.
20. Construct c chart for varying sample size.
21. OC Curve for Single Sampling Plan for attributes.
22. OC Curve for Single Sampling Plan for attributes (Varying acceptance number).
23. OC, AOQ and ATI Curve for Single Sampling Plan for attributes.

Text Book:

1. Dass M.N and Giri N.C (1986) Design and Analysis of Experiments, Wiley Eastern, New Delhi.
2. Gupta S. C. and Kapoor V. K (2015): Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.

DISCIPLINE SPECIFIC ELECTIVE – III (A)

Course Title: STOCHASTIC PROCESSES

Course Code:	Credits : 3
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. To make understand the student difference between Random variable and Random Process.
2. Understand the concept of Poisson Processes, Define the continuous time Markov chain and Branching process.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Understand the difference between Random variable and Random Process
CO2	Apply Markov property for estimating the future behavior of the process
CO3	To understand and solve the problems of stationary processes and time series
CO4	Define the continuous time Markov chain as birth and death processes and Poisson Process.
CO5	To understand the concept of branching process.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	2	2	1	2	2	3
CO2	2	2	2	2	2	2	2	2	1	3
CO3	2	2	3	2	1	1	2	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Basic Concepts : Definition and examples of stochastic process, classification of general stochastic processes into discrete and continuous time, discrete and continuous state spaces, types of stochastic processes, elementary problems.	9	CO1
II	Markov chains: Definition and examples of Markov chain, Transition Probability Matrix, classification of states, recurrence concepts, simple problems only. (No Derivations).	9	CO2
III	Basic limit theorem of Markov chain (statement only), stationary probability distribution, and its applications.	9	CO3
IV	Continuous Time Markov chain: Pure birth process and Poisson process, Birth and Death process, problems.	9	CO4
V	Branching process: Definition and examples of discrete time branching process, probability generating function, mean and variance, probability of extinction - simple problems.	9	CO5

Text Book:

1. Medhi, J. (1996): Stochastic processes, New Age International (p) Ltd.
2. Taylor, H.M. and Karlin, S. (1999): Stochastic Modelling, Academic press.

Books for Reference:

1. Hoel, P.M.G., Port, S.C. and Stone, C.J. (1991): Introduction to Stochastic processes, Universal Book Stall.
2. Parzen, E. (1962): Stochastic processes, Holden-Day. Ross, S.M. (1983): Stochastic processes, John Wiley.

Website Link:

1. <http://www.randomservices.org/random/>
2. <https://www.britannica.com/science/stochastic-process>

DISCIPLINE SPECIFIC ELECTIVE – III (B)

Course Title: ECONOMETRICS

Course Code:	Credits : 3
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. Know the scope and objectives of econometrics.
2. Understand models of econometrics and estimation of parameters of econometric models.
3. Understand multi-collinearity and auto correlation.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Explain the need and assumptions of Econometric models.
CO2	Discuss the Linear regression model and the significance of least square estimation.
CO3	Analyse the Multiple regression model and the practical applications of the model in real life situations.
CO4	Summarize the methods of detecting Multi-collinearity and remove it from the model.
CO5	Explain Auto correlation and to analyse the problems related to Auto correlated variables.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	2	2	1	2	2	3
CO2	2	2	2	2	2	2	2	2	1	3
CO3	2	2	3	2	1	1	2	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Definition – Scope – Objectives of Econometrics – Limitations – Divisions of Econometrics.	9	CO1
II	Single equation model two variable case – Reasons for introducing error term in the model – Estimation of error variance – Simple problems.	9	CO2
III	General Linear model – Assumptions – Least square method of estimation and testing of parameters of the model – problems under failure of assumptions.	9	CO3
IV	Concepts of price, Demand, supply, elasticity of demand, elasticity of price, elasticity of supply – simple problems.	9	CO4
V	Multi-collinearity: Introduction and concepts, detection of multi-collinearity, consequences, tests and solutions of multi-collinearity, specification error.	9	CO5

Text Book:

1. Gujarati, D. and Sangeetha, S. (2007): Basic Econometrics, 4th Edition, McGraw Hill Companies.
2. Johnston, J. (1972): Econometric Methods, 2nd Edition, McGraw Hill International.

Books for Reference:

1. Koutsoyiannis, A. (2004): Theory of Econometrics, 2nd Edition, Palgrave Macmillan Limited.
2. Maddala, G.S. and Lahiri, K. (2009): Introduction to Econometrics, 4th Edition, John Wiley & Sons.
3. Gupta S.P. & Kapoor V.K., Fundamentals of Applied Statistics, Sultan Chand & Sons, 2019.
4. Peter R Cox, Demography, 5th Edition, Vikas Publishing House, 1979.
5. Agarwal S.N, India's Population Problems, Tata McGraw Hill, 1981.
6. Srinivasan, K, Basic Demographic Techniques and Applications, Sage Publications, New Delhi, 1998.

Website Link:

1. <https://www.cdc.gov/csels/dsepd/ss1978/lesson3/section1.html>
2. <https://sites.google.com/site/econometricsacademy/masters-econometrics/simple-regression-model>

DISCIPLINE SPECIFIC ELECTIVE – III (C)

Course Title: ACTUARIAL STATISTICS

Course Code:	Credits : 3
L : 4 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning objectives:

1. To acquire the concept of interest, derive the different types of annuities.
2. Understanding concept of principles of insurances and concept of net premium of assurance.
3. To acquire the concept of mortality measurements and measures of fertility in vital statistics.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Know the concept of simple and compound interest describe and derive the different types of annuities.
CO2	Know the concept of premiums and adequacy of premiums, general principles, retrospective and prospective methods of valuation of liabilities.
CO3	To know the concept of principal of insurance and types of assurance.
CO4	Know the concept of mortality of Demographic data.
CO5	Know the concept of the Fertility, Measures of fertility, General fertility rate and Specific fertility rate.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	2	2	3	2	3	2	2	3
CO2	2	2	2	2	2	2	2	2	1	3
CO3	3	2	2	2	1	2	2	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Elements of simple & compound interest – Nominal rate and effective rate of interest – Relation between effective and nominal rate of interest – Present value – Annuity – Classifications of annuities – Accumulated values of annuities – Present value of deferred annuity certain – Accumulated value of deferred annuity certain – Simple problems.	9	CO1
II	Premiums – Natural premium – Level premium – Net premium – Office premium – Bonus loading with profit and without profit – Policy value – Retrospective policy value and prospective policy value.	9	CO2
III	Principle of insurance – Assurance benefits – Types of assurance – Endowment assurance, pure endowment assurance, whole life insurance and temporary assurance.	9	CO3
IV	Mortality measurements – Merits and Demerits – general and specific rates – standardized rates – age pyramid of sex composition – Ratios, proportions and percentage rates – Population pyramids, sex ratio, crude rate, specific rates, standard rates – direct and indirect – Simple problems.	9	CO4
V	Fertility, Measures of fertility, General fertility rate, Specific fertility rate, Net reproduction rate, Gross reproduction rate, Crude Rate of natural increase. Definition of stable population and stationery population – Simple Problems.	9	CO5

Text Book:

1. Mathematical basis of Life Assurance (IC-81), Published by Insurance Institute of India, Mumbai, 2020.
2. Gupta, S. C and Kapoor, V. K (2020), Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.

Books for References:

1. Dixit, S. P., Modi, C. S. & Joshi, R. V. Mathematical Basics of Life Assurance. Insurance Institute of India, Mumbai.
2. Frenk Ayres, J. R (1983). Theory and Problems of Mathematics of Finance. Schaum's Outline Series, McGraw-Hill book Company, Singapore.
3. Bogue, Donald. J: Principles of Demography, (1976), John Wiley, New York.

Web Resources

1. <https://medium.com/@mmahajan8/applications-of-actuarial-science-beyond-insurance-730b6ba8623e>
2. <https://actuaries.org.uk/standards/quality-assurance-scheme-qas/assurance-for-insurance/>
3. <https://www.thebalancemoney.com/what-is-an-insurance-actuary-4171820>
4. <https://www.math.utk.edu/~kbonee/123/2.3-2.4-problems-sol.pdf>
5. <https://www.annuityfyi.com/types-of-annuities/>
6. https://www.iiap.res.in/astrostat/School08/PennStateSchool08_LecNotes.pdf

CORE PROJECT

Course Title: **GROUP PROJECT**

Course Code:	Credits : 4
L : 0 T : 0 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. To determine a piece of technical knowledge in their selected project topic.
2. Undertake problem identification, formation and solution.
3. Develop plans with relevant people to achieve the goals of the project.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Identification of the research idea.
CO2	Analyse problem solving skills
CO3	Analyse sources for the conduct of research.
CO4	Evaluate the research report.
CO5	Create the research report.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	2	3	3	2	3	2	3
CO2	3	3	3	3	3	3	3	2	3	3
CO3	2	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	-
Teaching and Learning Methods	-
Assessment Methods	1. Internal Assessment : 40 Marks 2. External Assessment : 60 Marks 3. Total : 100 Marks

Course Content:

Cover page & Title page:

The fonts and locations of various items on this page should be exactly as shown in a specimen copy.

1. Inside cover page:

Inside cover page same as a cover page.

2. Bonafide Certificate:

The bonafide certificate shall be in double line spacing using Font Style Times New Roman and Font Size 14.

3. Acknowledgment:

This should not exceed one page.

4. Abstract:

The abstract should be one-page synopsis of the project report typed with double line spacing, Font Style Times New Roman, Font Size 14.

5. Contents:

The table of contents should list all headings, and subheadings after the table of contents page, as well as any titles preceding it. The title page and Bonafide Certificate will not find a place among the items listed in the Table of Contents. One-and a-half spacing should be adopted for typing the matter under this head.

6. Tables:

The list should use exactly the same captions as they appear above the tables in the text. 1.5 spacing should adopted for typing the matter under this head.

7. Figures:

The list should use exactly the same captions as they appear below the figures in the body of the text. One-and a-half spacing should be adopted for typing the matter under this head. All charts, graphs, maps, photographs, and diagrams should be designated as figures, X and Y axes titles are mandatory for all the graphs.

8. Symbols:

List of symbols, Abbreviations, and Nomenclature: 1.5 spacing should be adopted or typing the matter under this head. Standard symbols, abbreviations, etc. should be used.

Chapter I

Introduction: Statement of the Problem, significance, Need for the study, Objectives.

Chapter II

Review of Literature.

Chapter III

Methodology: Tools Used, Procedure, Hypothesis.

Chapter IV

Results and Discussion: Tables and Figures, Statistical Presentations, Hypothesis Testing.

Chapter V

Summary and Conclusion.

Chapter VI

Scope of the project.

References

References

EXTENSION ACTIVITY

Course Title: EXTENSION ACTIVITY

Course Code:	Credits : 1
L : 0 T : 0 P : 0 S : 0	CIA Marks :
Exam Hours:	ESE Marks :

1. At least two activities should be conducted with in semester consisting of two days each.
2. The activities may be Educating Rural Children, Unemployed Graduates, Self Help Group etc.

Offered to Other Departments

- 1. B. A., Sociology**
- 2. B. Sc., Computer Science**
- 3. B. Sc., Data Science**



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DEPARTMENT OF STATISTICS (SHIFT-II)

Course Offered to B. A., SOCIOLOGY
Multi-Disciplinary Elective / Open Elective

SCHEME OF EXAMINATIONS

Course Components / Title of the Paper	Semester	Credits	MARKS		
			INT	EXT	TOTAL
Statistics for Sociology	V	3	50	50	100
Total	-	3	50	50	100

MULTI-DISCIPLINARY ELECTIVE

Course Title: STATISTICS FOR SOCIOLOGY

Course Code:	Credits : 3
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning objectives:

1. To define the type and quantity of data need to be collected.
2. To organize and summarize the data.
3. Analyse statistical data using measures of central tendency, dispersion and location.
4. Use simple correlation and regression to analyse the relationships between the variables.
5. Demonstrate the importance and applications of hypothesis testing.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Students come to know how to collect and classify the data and its limitations.
CO2	Students Come to know measures of location.
CO3	Students Come to know measures of dispersion.
CO4	Students Know correlation with different method and Concept of Regression.
CO5	Students know the concepts of hypothesis testing.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	3	3	3	2	2
CO2	3	1	3	2	2	2	2	1	2	3
CO3	2	2	2	2	2	1	2	2	2	2
CO4	2	2	2	3	2	2	1	3	2	1
CO5	1	2	3	2	3	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Introduction to Statistics: Meaning and Definition – Importance, Scope of Statistics, Application of Statistics in various fields in States of Statistics – Functions and Limitations of Statistics - Methods of Collecting Data - Primary and Secondary Data - Sources of Data – Sampling methods - Classification and Tabulation of Data.	9	CO1
II	Measures of Location: Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean and their properties - Merits and Demerits.	9	CO2
III	Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation, Skewness and Kurtosis and their properties.	9	CO3
IV	Correlation and Regression: Definition - Types and uses of Correlation – Scatter diagram – Karl Pearson’s Co-efficient of Correlation - Spearman’s Rank Correlation – Meaning and uses of Regression – Construction of Regression Equations – Difference between Correlation and Regression.	9	CO4
V	Concept of Statistical Hypothesis: Simple and Composite Hypothesis – Null and Alternative Hypothesis – Critical region – Type I and Type II Errors – Sampling distribution and Standard Error. Large Sample Tests – Test for Single Mean, Difference of Means, Single Proportion and Difference of Proportions.	9	CO5

Note: Theory 80 % and Problem 20% questions to be asked.

Text Books:

1. P. R. Vittal and V Malini (2002): Mathematical Statistics, Margham Publications.
2. Gupta, S.C and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2002.

Books for References:

1. Gupta S.P. (2012). Statistical Methods, Sultan Chand & Sons, New Delhi.
2. R.S.N. Pillai and V. Bagavathi (1999). Statistics – Theory and Practice, S. Chand & Sons Company Ltd, New Delhi.
3. Vittal P.R. (2012). Business Mathematics and Statistics, Margham Publications, Chennai.
4. Saxena H. C (1983), Elementary Statistics, Sultan Chand & Sons, New Delhi.

Website Link:

1. <https://www.tutorialspoint.com/statistics/>
2. <https://www.emathzone.com/tutorials/basic-statistics/collection-of-statistical-data.html>



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DEPARTMENT OF STATISTICS (SHIFT-II)

Courses Offered to B. Sc., COMPUTER SCIENCE

SCHEME OF EXAMINATIONS

Course Components / Title of the Paper	Semester	Credits	MARKS		
			INT	EXT	TOTAL
Statistical Methods for Computer Science – I	III	3	50	50	100
Statistical Methods for Computer Science – II	IV	3	50	50	100
Total	-	6	100	100	200

GENERIC ELECTIVE III

Course Title: **STATISTICAL METHODS FOR COMPUTER SCIENCE – I**

Course Code:	Credits : 3
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

To motivate the students to understand the theoretical concepts in statistics and make them to apply the concepts in their respective major subjects.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Collection, classification of the data and its limitations and how to represent/compare the data using diagrams and graphs.
CO2	Evaluate Measures of locations.
CO3	Evaluate Measures of dispersion.
CO4	Evaluate the measures of skewness Karl Pearson's, Bowley's Coefficient of Skewness and Kurtosis.
CO5	Evaluate Correlation and Regression analysis and Curve fitting: Straight line method.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO 5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	3	3	3	2	2
CO2	3	1	3	2	2	2	2	1	2	3
CO3	2	2	2	2	2	1	2	2	2	2
CO4	2	2	2	3	2	2	1	3	2	1
CO5	1	2	3	2	3	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Introduction – Scope and limitations of Statistical methods – Classification of data – Tabulation of data – Diagrammatic and Graphical representation of data – Graphical determination of Percentiles and Quartiles.	9	CO1
II	Measures of Locations: Arithmetic mean, Median, Mode, Geometric mean, Harmonic mean - merits and demerits – Simple problems.	9	CO2
III	Measures of Dispersion: Absolute and Relative measures, Range, Quartile deviation, Mean deviation, Standard deviation – Coefficient of variation – Simple problems.	9	CO3
IV	Measures of Skewness: Karl Pearson's, Bowley's, Kelly's Coefficient of Skewness and Kurtosis – Simple problems.	9	CO4
V	Correlation: Scatter diagram, Karl Pearson's, Spearman's rank correlation coefficient. Regression Analysis: Simple regression equations. Curve fitting by the method of least squares: Straight line method – Simple problems.	9	CO5

Text Books:

1. "Fundamentals of Mathematical Statistics" (11th edition – 2002), Gupta. S. C. and Kapoor. V. K., Sultan Chand & Sons, New Delhi.
2. "Statistical Methods" (32nd edition - 2004), Gupta. S. P., Sultan Chand & Sons, New Delhi.

Reference Books:

1. "Statistics (Theory and Practice)" (3rd edition - 1993), Pillai. R. S. N. and Bagavathi. V. Sultan Chand & Sons, New Delhi.
2. "Fundamentals of Statistics – Volume II" (6th edition - 1990), Goon. A. M., Gupta. M. K. and Dass Gupta. B, The World Press Private Ltd., Calcutta.
3. "Mathematical Statistics" (1st edition – 2002), Vittal. P. R., Margham Publications, Chennai – 17

Website Link:

1. https://www.tutorialspoint.com/class_11th_statistics_for_economics/index.asp
2. <https://www.surveysystem.com/correlation.htm>
3. <https://investopedia.com/terms/r/regression.asp>
4. <https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression>

GENERIC ELECTIVE IV

Course Title: **STATISTICAL METHODS FOR COMPUTER SCIENCE – II**

Course Code:	Credits : 3
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

To motivate the students to understand the theoretical concepts in statistics and make them to apply the concepts in their respective major subjects.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Understand the basics of Probability and Baye's theorem.
CO2	Solve the problems of PDF, PMF and expectation of probability
CO3	Evaluate the distributions of binomial, Poisson and Normal.
CO4	Evaluate the testing of hypothesis for small samples.
CO5	Evaluate the testing of hypothesis for large samples.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO 5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	3	3	3	2	2
CO2	3	1	3	2	2	2	2	1	2	3
CO3	2	2	2	2	2	1	2	2	2	2
CO4	2	2	2	3	2	2	1	3	2	1
CO5	1	2	3	2	3	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Sample Space – events – Definition of Probability, Addition and Multiplications theorems – simple problems. Conditional probability – Baye’s theorem (only theorem).	9	CO1
II	Concept of Random Variable – Probability mass function, Probability density function and Distribution function. Mathematical Expectation: Properties of expectations, Chebychev’s inequality (only theorem).	9	CO2
III	Standard distributions: Binomial (mean and variance) Poisson (mean and variance) and fitting of these distributions. Normal distributions (characteristics and area problems).	9	CO3
IV	Concept of Sampling distributions – Standard Error – Tests of Significance based on small samples – t, F and Chi-Square distributions. Chi – Square test for independence of attributes. Goodness of fit – simple problems.	9	CO4
V	Tests of Significance based on Large samples – Test for a specified and equality of two means – Test for a specified and equality of two proportions – Test for a specified and equality of two standard deviations – Simple problems.	9	CO5

Text Books:

1. “Fundamentals of Mathematical Statistics” (11th edition – 2002), Gupta. S. C. and Kapoor. V. K., Sultan Chand & Sons, New Delhi.
2. “Statistical Methods” (32nd edition - 2004), Gupta. S. P., Sultan Chand & Sons, New Delhi.
3. “Fundamentals of Applied Statistics” (2nd edition – 1978), Gupta. S. C. and Kapoor. V. K., Sultan Chand & Sons, New Delhi.

Reference Books:

1. “Statistics (Theory and Practice)” (3rd edition - 1993), Pillai. R. S. N. and Bagavathi. V., Sultan Chand & Sons, New Delhi.
2. “Fundamentals of Statistics – Volume II” (6th edition - 1990), Goon. A. M., Gupta. M. K. and Dass Gupta. B, The World Press Private Ltd., Calcutta.
3. “Mathematical Statistics” (1st edition – 2002), Vittal. P. R., Margham Publications, Chennai – 17.

Website Link:

1. <https://seeing-theory.brown.edu/probability-distributions/index.html>
2. <https://www.kullabs.com/classes/subjects/units/lessons/notes/note-detail/9557>
3. <https://www.statisticssolutions.com/mathematical-expectation/>
4. <http://itfeature.com/statistics/measure-of-dispersion/moments-in-statistics>
5. <https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library>

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DEPARTMENT OF STATISTICS (SHIFT-II)

Courses Offered to B. Sc., DATA SCIENCE

SCHEME OF EXAMINATIONS

Course Components / Title of the Paper	Semester	Credits	MARKS		
			INT	EXT	TOTAL
Statistical Methods and Its Applications	I	3	50	50	100
Probability and Statistics	II	3	50	50	100
Optimization Techniques	III	3	50	50	100
Statistical Analysis Using R	IV	3	50	50	100
Total	-	12	200	200	400

GENERIC ELECTIVE I

Course Title: **STATISTICAL METHODS AND ITS APPLICATIONS**

Course Code:	Credits : 3
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

- To Define the type and quantity of data need to be collected.
- To Organize and summarize the data.
- To Analyze the data and drawing conclusions from it.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Students come to know how to collect and classify the data and its limitations. Students know how to resent/compare the data using Diagrams and Graph.
CO2	Students Come to know measures of location.
CO3	Students Come to know measures of dispersion.
CO4	Students Know correlation with different methods, Partial and Multiple correlation
CO5	Students know the concepts of Regression analysis for different data and different methods, concept of curve fitting and exponential random graph models.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO 5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	3	3	3	2	2
CO2	3	1	3	2	2	2	2	1	2	3
CO3	2	2	2	2	2	1	2	2	2	2
CO4	2	2	2	3	2	2	1	3	2	1
CO5	1	2	3	2	3	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Nature and Scope of Statistical Methods and Their Limitations – Collection, Classifications, Tabulation and Diagrammatic Representation of various types of statistical data – Frequency Curves and Ogives – Graphical determination of percentiles quartiles and their properties – Merits and Demerits.	9	CO1
II	Measures of Location: Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean – Merits and Demerits – Simple Problems.	9	CO2
III	Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation, Skewness and Kurtosis – Simple Problems.	9	CO3
IV	Correlation: Definition, Scatter diagram, Karl Pearson's, Spearman's rank and Concurrent deviation methods, Partial and Multiple correlation (Definition Only) – Simple problems.	9	CO4
V	Regression Analysis: Regression Lines, Regression equations, Regression Coefficients, Properties of regression coefficients – Simple Problems. Curve fitting – Principle of Least squares – Fitting of first degree and second degree polynomial – Simple problems.	9	CO5

Text Books:

1. Gupta, S.C and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2002.
2. Freund J.E (2001): Mathematical Statistics, Prentice Hall of India.
3. Goon A.M., Gupta M.K., Das Gupta.B. (1991): Fundamentals of Statistics, Vol.I, World Press, Calcutta.

Books for References:

1. Bhat B.R. Srivenkatramana T and Rao Madhava K.S. (1997): Statistics: A Beginner's Text, Vol. II, New Age International (P) Ltd.
2. Rohatgi V.K (1967): An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
3. Snedecor G.W and Cochran W. G. (1967): Statistical Methods. Iowa State University Press.

Website Link:

1. https://www.tutorialspoint.com/class_11th_statistics_for_economics/index.asp
2. <https://www.surveysystem.com/correlation.htm>
3. <https://investopedia.com/terms/r/regression.asp>
4. <https://www.bmj.com/about-bmj/resources-readers/publications/statistics-square-one/11-correlation-and-regression>

GENERIC ELECTIVE II

Course Title: **PROBABILITY AND STATISTICS**

Course Code:	Credits : 3
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

1. To introduce the basic concepts of probability.
2. To introduce the basic concepts of random variables.
3. To introduce the basic concepts of two dimensional random variables.
4. To familiarize the knowledge of standard distributions which plays an important role in real life problems.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Students know the Basic Concept of Probability,
CO2	Random variables and Mathematical Expectations.
CO3	Calculate Probabilities, and derive the Marginal and Conditional Distributions of Bivariate Random variables.
CO4	Students Know some Discrete Distributions
CO5	Students Know some Continuous Distributions

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO 5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	3	3	3	2	2
CO2	3	1	3	2	2	2	2	1	2	3
CO3	2	2	2	2	2	1	2	2	2	2
CO4	2	2	2	3	2	2	1	3	2	1
CO5	1	2	3	2	3	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Probability: Random Experiment, Sample space, Events, Equally likely, Mutually Exclusive and Exhaustive Events, Addition and Multiplications Theorems, Independence of Events – Conditional Probability – Bayes Theorem.	9	CO1
II	Random Variables: Random variables , Probability Mass function , Probability density Function, Distribution Function, Properties of Mathematical Expectation, Moments of Random Variable (raw and central moments) – Moment Generating Function.	9	CO2
III	Two Dimensional Random Variables: Joint distributions – Marginal and conditional distributions, Central limit theorem (for independent and identically distributed random variables) – Simple Problems.	9	CO3
IV	Discrete Distributions: Binomial (Mean & Variance), Poisson (Mean & Variance) and Fitting of these distributions, Geometric distribution (Mean & Variance) and Simple problems.	9	CO4
V	Continuous Distributions: Uniform (Mean & Variance), Exponential (Mean & Variance) and Normal distributions (Mean & Variance) and simple problems.	9	CO5

Text Books:

1. Gupta, S.C and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2002.
2. Freund John, E and Miller, Irvin, “Probability and Statistics for Engineering”, 5th Edition, Prentice Hall, 1994.

Books for References:

1. Jay, L. Devore, “Probability and Statistics for Engineering and Sciences”, Brooks Cole Publishing Company, Monterey, California, 1982.
2. Hodges J.L and Lehman E.L (1964): Basic Concepts of Probability and Statistics, Holden Day.
3. Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.

Website Link:

1. <https://seeing-theory.brown.edu/probability-distributions/index.html>
2. <https://www.kullabs.com/classes/subjects/units/lessons/notes/note-detail/9557>
3. <https://www.statisticssolutions.com/mathematical-expectation/>
4. <http://itfeature.com/statistics/measure-of-dispersion/moments-in-statistics>
5. <https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library>

GENERIC ELECTIVE III

Course Title: OPTIMIZATION TECHNIQUES

Course Code:	Credits : 3
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning Objectives:

The objective of this course is to enable the student to

1. Formulate and solve Linear Programming Problems (LPP)
2. Evaluate, Transportation and Assignment Problems.
3. Obtain solution to Network Problems using CPM and PERT Techniques.
4. Identify and solve problems under Game Theory.
5. Identify and solve problems under Markovian Queuing Models.

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Recall the theoretical foundations of various issues related to linear programming modeling to formulate real-world problems as a LPP model
CO2	Find the optimum solution of Transportation and Assignment models.
CO3	Find the solution to network problems using CPM and PERT techniques.
CO4	Find the solution to Game Theory Problems.
CO5	Find the solution to Queuing Theory Problems.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO 5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	3	2	2	3	3	3	2	2
CO2	3	1	3	2	2	2	2	1	2	3
CO3	2	2	2	2	2	1	2	2	2	2
CO4	2	2	2	3	2	2	1	3	2	1
CO5	1	2	3	2	3	2	3	2	1	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Linear Models: Introduction of Operations Research – Mathematical Formulation of LPP – Graphical Methods to solve LPP – Simplex Method – Big M method.	9	CO1
II	Transportation and Assignment Problems: Transportation problems – obtaining initial feasible and optimal solutions, optimality test, unbalanced transportation problems. Assignment problems and unbalanced assignment problems.	9	CO2
III	Project Scheduling: Project network -Diagram representation – Floats – Critical Path Method (CPM) – PERT.	9	CO3
IV	Game Theory: Game Theory – Two person zero sum games, The Maximin – Minimax principle – Games without saddle points – Mixed strategies – Graphical solution of $2 \times n$ and $m \times 2$ games Dominance property.	9	CO4
V	Queuing Models: Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituents of a Queuing system, Service facility, Queue discipline, Single channel with finite and infinite capacity models.	9	CO5

Text Book:

1. Swarup Kanti, Gupta PK (Dr), Mohan Man, Operations Research, Sultan Chand & Sons, 20th Edition, 2022

Books for References:

1. ND Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 4th Edition, 2011.
2. J. K. Sharma, Operations Research Theory and Applications, Macmillan, 5th Edition, 2012.
3. Hiller F.S, Liberman G.J, Introduction to Operations Research, 10th Edition McGraw Hill, 2017.
4. Ravindran A., Philip D.T., and Solberg J.J., Operations Research, John Wiley, 2nd Edition, 2007.
5. Hamdy A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2017.

Website Link:

1. <https://nptel.ac.in/courses/111/107/111107128/>
2. <https://nptel.ac.in/courses/112/106/112106134/>
3. https://onlinecourses.swayam2.ac.in/cec20_ma10/preview

GENERIC ELECTIVE IV

Course Title: STATISTICAL ANALYSIS USING R

Course Code:	Credits : 3
L : 3 T : 1 P : 0 S : 0	CIA Marks : 50 Marks
Exam Hours: 3 Hrs.	ESE Marks : 100 Marks

Learning objectives:

1. To make understand the student about basics of R programming language, latest analytics Tool
2. Understand the concept of data analysis, existing functions in R and z test, t-test, F- test, chi-square test
3. To make understanding the students through computer programming.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Basics of R programming language.
CO2	To know the concept of diagrams and measures of central tendency.
CO3	To know the concept of measures of dispersion, skewness, kurtosis, correlation and regression use R.
CO4	To create formulae for probability and distributions use R.
CO5	Understand the concept of One- and two-sample tests, z test, t-test, F- test, chi-square test of independence.

Mapping of CO with PO & PSO:

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	2	3	2	2	1	2	2	3
CO2	2	2	2	2	2	2	2	2	1	3
CO3	2	2	3	2	1	1	2	2	2	2
CO4	2	3	3	3	2	2	3	2	2	2
CO5	2	2	1	2	2	2	2	2	2	3

3-Strong 2-Medium 1-Low

Tutorial Schedule	Group Discussion, Quiz and Group Activities.
Teaching and Learning Methods	Chalk and Board Teaching, Power Point Presentation and Virtual Learning.
Assessment Methods	Attendance, Assignment, Seminar, CIA – I, CIA – II and ESE.

Module	Contents of Module	Hrs	COs
I	Introduction to R: What is R? – Installing and loading R package – Arithmetic and Logical Operations – Data structure – Control Statements – loops – getting help, Graphics in R, built in functions.	9	CO1
II	Descriptive statistics: Diagrammatic representation of data (box plots, bar plots, pie diagram, scatter plots, histogram, spike graph, frequency polygon, Ogives), preparation of frequency distribution. Measures of central tendency: Mean, median, mode, geometric mean and harmonic mean, partition values.	9	CO2
III	Measures of dispersion: Range, quartile deviation, mean deviation, standard deviation, variance, coefficient of variation and summaries of a numerical data. Measures of skewness and kurtosis, Correlation and Regression: Karl Pearson's co-efficient, Spearman's rank correlation coefficient, Regression Equations.	9	CO3
IV	Probability and Distributions: Discrete and continuous random variables – Probability mass and density functions, cumulative distribution function. Discrete distributions: Binomial distribution, Poisson distribution, hyper geometric distribution. Continuous distributions: Normal Distribution, Plots to check Normality, Exponential distribution.	9	CO4
V	Inferential Statistics: classical tests: One and two-sample tests, z test, t-test, F-test, chi-square test of independence and goodness of fit, time series models (Concept only).	9	CO5

Text Books:

1. Michale J. Crawley, THE R BOOK, John Wiley & Sons, England (2009)
2. Sudha G. Purohit et.al., Statistics Using R, Narosa Publishing House, , India(2008)

Books for Reference:

1. John Verzani, simple R-Using R for Introductory Statistics, (<http://www.math.csi.cuny.edu/Statistics/R/SimpleR/Simple.>)
2. W. N. Venables, D. M. Smith and the R Core Team, An Introduction to R , Notes on R: A Programming Environment for Data Analysis and Graphics, Version 2.15.2 (2012-10-26) (<http://www.r-project.org>)
<https://christopencourseware.com/course/Statistical+Analysis+using+R>

Website Link:

1. <https://cran.r-project.org/doc/contrib/Owen-TheRGuide.pdf>
2. <https://sphweb.bumc.bu.edu/otlt/MPH-Modules?BS/R/R-Manual/R-Manual2.html>
3. <https://smac-group.github.io/ds/>