திருவள்ளுவர் பல்கலைக்கழகம்

THIRUVALLUVAR UNIVERSITY

(State University Accredited with "B+" Grade by NAAC)

Serkkadu, Vellore - 632 115, Tamil Nadu, India.

SYLLABUS

BACHELOR OF SCIENCE

B.Sc. DEGREE COURSE in STATISTICS

(with effect from 2022 – 2023)

THIRUVALLUVAR UNIVERSITY

BACHELOR OF SCIENCE

B.Sc. DEGREE COURSE in STATISTICS

(With effect from 2022 - 2023)

Programme Objectives

1. Professional behaviour such as being objective, unbiased and truthful in all aspects of work.
2. Professionally competent to face the challenges in the Society.
3. Procedural knowledge that creates different types of professionals related to subject area of Statistics, including professionals engaged in government/public/private sectors.
4. Sensitive to real experiences with respect to self, society and nation.
5. Develop independent, coherent and decisive thoughts among the students that will ultimately develop competency in their lives.

Programme Educational Objectives

1. Employability of students in industry as well as in academics in the core field or applied field of statistics.
2. Leading to pursue higher studies in the core or allied field of statistics.
3. Aware of values and beliefs of different cultures and have a global perspective by examining various forms of primary and secondary data resources.
4. Develop effective and confident Communication skill and have an ability to work in a team as well as in isolation.
5. Develop the skills for formulating the problem and providing the solution.

Programme Specific Outcomes

1. Theoretical and applied statistical concepts with adequate preparation leading to pursue post graduate degree in top institutions.
2. Become an entrepreneur / consultant for data analysis related projects.
3. Successfully relate theoretical concepts to a real world problem.
4. Applied knowledge on statistics via statistical computing and programming helps to make better decision on issues related to society.

5. Fundamental/systematic/coherent understanding of the Statistics and its different learning areas and applications leads to get through the various examinations for job placement.
6. Familiarize the computational techniques and software used in the statistical arena,
7. Capacity to learn any programming language and prepare the scripts to solve the model formulation of given data.
8. Provide a solid ground in the best practices of collating and disseminating information.
9. Design statistical model in the real world problems and finding the optimal solution.
10. Analyse, interpret and draw appropriate conclusions from both quantitative and qualitative data and critically evaluate ideas with an unbiased and consistent approach.

Programme Outcomes

1. Familiar with data collection, compilation, analysis and interpretation using appropriate statistical methodologies.
2. Systematic knowledge of an academic field of study and its applications with a number of emerging issues.
3. Skills in the areas related to current developments in applications of Statistics.
4. Recognize the importance of statistical modelling and computing.
5. Ability to understand the various assumptions, scope and limitations of statistical tools.
6. The role of approximation and mathematical approaches to analyse the real problems using various statistical tools.
7. Plan and execute Statistical experiments/investigations for the collected information, analyse and report accurately the findings using appropriate methods.
8. Gain the relevant generic skills and global competencies such as problem-solving skills, communication skills, analytical skills, ICT skills, personal skills such as the ability to work both independently and in a group.
9. Examine the various hypotheses involved, and able to identify the relevant statistical procedures and draw valid conclusions.
10. Gain practical exposure of statistical techniques via real time data.

THIRUVALLUVAR UNIVERSITY

BACHELOR OF SCIENCE

B.Sc. STATISTICS

DEGREE COURSE

(With effect from 2022 - 2023)

The Course of Study and the Scheme of Examinations

S. No.	Part	Study Components / Course Title		Ins. Hrs / week	Credit	Title of the Paper	Maximum Marks		
SEMESTER I							**CIA**	**Uni. Exam**	**Total**
1.	I	Language	Paper-1	6	4	Tamil/Other Languages	25	75	100
2.	II	English (CE)	Paper-1	6	4	**Communicative English I**	25	75	100
3.	III	Core Theory	Paper-1	6	4	Descriptive Statistics	25	75	100
	III	Core Practical	Practical-1	4	0	Statistical Practical-I	-	-	-
4.	III	Allied	Paper-1	6	3	Mathematics-I	25	75	100
5.	**III**	**PE**	**Paper 1**	**6**	**3**	**Professional English I**	**25**	**75**	**100**
6.	IV	Environmental Studies		2	2	Environmental studies	25	75	100
		Sem. Total		**36**	**20**		**150**	**450**	**600**
SEMESTER II							**CIA**	**Uni. Exam**	**Total**
7.	I	Language	Paper-2	6	4	Tamil/Other Languages	25	75	100
8.	II	English (CE)	Paper-2	4	4	**Communicative English II**	25	75	100
9.	**II**	**NMSDC I : Language Proficiency for Employability**	**Paper-1**	**2**	**2**	**Effective English**	**25**	**75**	**100**
10.	III	Core Theory	Paper-2	5	4	Probability and Random Variables	25	75	100
11.	III	Core Practical	Practical-1	3	4	Statistical Practical-I	40	60	100
12.	III	Allied	Paper-2	6	3	Mathematics-II	25	75	100
13.	**III**	**PE**	**Paper 1**	**6**	**3**	**Professional English II**	25	75	100
14.	IV	Value Education		2	2		25	75	100
15.	IV	Soft Skill		2	1		25	75	100
		Sem. Total		**36**	**27**		**240**	**660**	**900**
SEMESTER III							**CIA**	**Uni. Exam**	**Total**
16.	I	Language	Paper-3	6	4	Tamil/Other Lang.	25	75	100
17.	II	English	Paper-3	6	4	English	25	75	100
18.	III	Core Theory	Paper-3	4	4	Distribution Theory	25	75	100
	III	Core Practical	Practical-2	2	-	Statistical Practical-II	-	-	-
19.	III	Allied	Paper-3	4	3	Numerical Methods	25	75	100
		Allied Practical	Practical-1	2	-	Numerical Methods and Programming in C	-	-	-
20.	IV	Skill Based	Paper-1	3	2	Elementary Mathematics	25	75	100

		Subject							
21.	IV	Non-Major Elective	Paper-1	3	2	Statistical Methods-I	25	75	100
		Sem. Total		**30**	**19**		**150**	**450**	**600**
SEMESTER IV							**CIA**	**Uni. Exam**	**Total**
22.	I	Language	Paper-4	6	4	Tamil/Other Lang.	25	75	100
23.	II	English	Paper-4	6	4	English	25	75	100
24.	III	Core Theory	Paper-4	4	4	Sampling Theory	25	75	100
25.	III	Core Practical	Practical-2	4	4	Statistical Practical-II	40	60	100
26.	III	Allied	Paper-4	3	3	Programming in C	25	75	100
27.	III	Allied Practical	Practical-1	3	2	Numerical Methods and Programming in C	40	60	100
28.	**IV**	**NMSDC II : Digital Skills for Employability**	**Paper-2**	**2**	**2**	**Office Fundamentals**	**25**	**75**	**100**
29.	IV	Non-Major Elective	Paper-2	2	2	Statistical Methods-II	25	75	100
		Sem. Total		**30**	**25**		**245**	**555**	**800**
SEMESTER V							**CIA**	**Uni. Exam**	**Total**
30.	III	Core Theory	Paper-5	6	4	Estimation Theory	25	75	100
31.	III	Core Theory	Paper-6	5	4	Statistical Quality Control	25	75	100
32.	III	Core Theory	Paper-7	5	4	Operations Research	25	75	100
33.	III	Core Theory	Paper-8	5	4	Applied Statistics	25	75	100
	III	Core Practical	Practical-3	3	-	Statistical Practical-III	-	-	-
34.	III	Internal Elective	Paper-1	4	3	(Choose 1 out of 2) A. Demography B. Database Management System	25	75	100
35.	IV	Skill Based Subject	Paper-2	2	2	Indian Official Statistics	25	75	100
		Sem. Total		**30**	**21**		**150**	**450**	**600**
SEMESTER VI							**CIA**	**Uni. Exam**	**Total**
36.	III	Core Theory	Paper-9	5	4	Testing Statistical Hypotheses	25	75	100
37.	III	Core Theory	Paper-10	5	4	Design of Experiments	25	75	100
38.	III	Core Theory	Paper-11	4	4	Stochastic Processes	25	75	100
39.	III	Core Practical	Practical-3	3	4	Statistical Practical-III	40	60	100
40.	III	Compulsory Project	Project -1	5	5	Group / Individual Project	25	75	100
41.	III	Internal Elective	Paper-2	3	3	(Choose 1 out of 2) A. Mathematical Economics B. Real Analysis	25	75	100
42.	III	Internal Elective	Paper-3	3	3	(Choose 1 out of 2) A. Statistical Genetics B. Actuarial Statistics	25	75	100
43.	**III**	**NMSDC III : Data Analytics with Advance Tools for Employability**	**Paper-3**	**2**	**2**	**Project Based Learning III**	**40**	**60**	**100**
44.	V	Extension Activities			1		100	-	100
		Sem. Total		**30**	**30**		**330**	**570**	**900**
		Grand Total			**142**				**4300**

Note:
Practical: Internal Tests (25 Marks) + Practical Record (15 Marks) = 40 Marks
Project: Evaluation of Project (50 Marks) + Project Viva-voce (25 Marks) = 75 Marks
Reference Materials: Students can refer e-books and e-materials from e-PG Pathshala website, https://epgp.inflibnet.ac.in, an initiative of the MHRD, Govt. of India, executed by UGC.

Part	Subject	Papers	Credits	Total Credits	Marks	Total Marks
Part I	Languages	4	4	16	100	400
Part II	Communicative English & English	4	4	16	100	400
Part III	Core	11	4	44	100	1100
	Core practical	3	4	12	100	300
	Internal Electives	3	3	9	100	300
	Compulsory Project (Group/Individual Project)	1	5	5	100	100
	Allied	4	3	12	100	400
	Allied Practical	1	2	2	100	100
	Professional English	2	3	6	100	200
Part IV	Environmental Studies	1	2	2	100	100
	Value Education	1	2	2	100	100
	Soft Skill	1	1	1	100	100
	Non-Major Electives	2	2	4	100	200
	Skill Based Subjects	4	2	8	100	400
Part V	Extension Activities	1	1	1	100	100
	Total	**43**	**-**	**140**	**-**	**4300**

THIRUVALLUVAR UNIVERSITY
VELLORE - 632 115

B.Sc. STATISTICS

CBCS Pattern
(With effect from 2022-2023)

List of Core / Allied / Elective / Skill based / Non-Major Elective Subjects

Core Subjects

1. Descriptive Statistics
2. Probability and Random Variables
3. Statistical Practical - I
4. Distribution Theory
5. Sampling Theory
6. Statistical Practical - II
7. Estimation Theory
8. Statistical Quality Control
9. Operations Research
10. Applied Statistics
11. Testing Statistical Hypotheses
12. Design of Experiments
13. Stochastic Processes
14. Statistical Practical – III
15. Project with Viva-voce

Allied Subjects (for students of Statistics)

1. Mathematics - I
2. Mathematics – II
3. Numerical Methods
4. Programming in C
5. Numerical Methods and Programming in C (Allied Practical – I)

Core (Internal) Elective Subjects (for students of Statistics)

1. Demography
2. Database Management System
3. Mathematical Economics
4. Real Analysis
5. Statistical Genetics
6. Actuarial Statistics

Skill based Subjects (for students of Statistics)

1. Elementary Mathematics
2. Statistical Data Analysis – I (Using R Programming)
3. Indian Official Statistics
4. Statistical Data Analysis – II (Software based)

Non-Major Elective Subjects (for students of other departments)

1. Statistical Methods – I
2. Statistical Methods - II

Semester: I **Paper type:** Core **Paper code:**

Name of the Paper: DESCRIPTIVE STATISTICS **Credits:** 4

Total Hours per Week: 6 **Lecture Hours:** 4 **Tutorial Hours:** 1 **Practical Hours:** 1

……

Course Objectives

1. Impart the scope and limitations of statistics
2. Inculcate knowledge on visualization of data in the form of tables and diagrams
3. Compute various Measures of location and dispersions
4. Study the knowledge on bivariate data, correlation and regression
5. Learn the concept of consistency of data

Course Outcomes

The student will be able to

1. Understand the theory and applications of basic statistics
2. Analyse the various techniques of presentation of data
3. Solve problems on measures of location and dispersion
4. Perform correlation and regression analysis
5. Knowledge of other types of data reflecting quality characteristics including concepts of independence and association between two attributes

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓				
2	✓	✓		✓	✓	
3	✓	✓	✓	✓	✓	
4	✓	✓	✓	✓	✓	✓
5	✓	✓	✓	✓	✓	✓

UNIT – I

Nature and scope of statistical methods and their limitations - preparation of questionnaire and schedule - Primary and Secondary sources of data - nominal, ordinal, ratio and interval scale - complete enumeration, controlled experiment, observational studies & sample surveys, Sources of secondary data including some Government publications.

UNIT – II

Presentation by tables and by 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.

UNIT – III

Measures of Location – mean, median, mode - Measures of dispersion, moments, measures of skewness and kurtosis for both grouped and ungrouped data.

UNIT – IV

Scatter diagram, regression lines and concept of error in regression, principle of least squares and fitting of first, second degree and exponential curves, concept of correlation co-efficient and its properties. Spearman's rank correlation. Regression Equations.

UNIT – V

Fundamental set of frequencies, Consistency of data, conditions for consistency, contingency table, association of attributes.

Text Books:

1. Hogg, R.V. and Craig, A.T. (1998): Introduction to Mathematical Statistics, 4th ed. Academic Press.
2. Hoel, P.G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.
3. Goon, AM., Gupta M.K and Dasgupta B (1991): Fundamentals of Statistics, Vol.1, World Press, Calcutta.
4. Bhat B.R, Srivenkataramana T, and Madhava K.S,(1996) Statistics: A Beginner's text Vol. I, New Age International (P) Ltd.
5. Gupta,S.P. (2014):Statistical Methods, Sultan Chand & Sons Pvt Ltd. New Delhi.
6. S.C.Gupta. V. K. Kapoor (Reprint 2019)Funamentals of Mathematical Statistics , Sultan Chand & Sons Pvt Ltd, New Delhi.

Reference Books:

1. G.U.Yule and M.G. Kendall (1956): An introduction to the theory of Statistics, Charles Griffin.
2. M.R. Spiegel (1961): Theory and problems of statistics, Schaum's outline series.
3. Snedecor .G.W. and Cochran W.G. (1967): Statistical methods, Iowa State University Press.
4. Anderson, T.W. and Sclove SL. (1978): An introduction to statistical analysis of data, Houghton Miffin/co.
5. Croxton FE, and Cowden D.J. (1973) Applied General Statistics, Printice Hall of India.

Course Material: website links, e-Books and e-journals

1. **https://nptel.ac.in/courses/111/104/111104120/**
2. **https://www.iiserpune.ac.in/~bhasbapt/phy22/ files/curvefitting pdf**
3. **https://onlinecoursees ,swayam2,ac.in/cec21_ma01/preview**
4. https://www.coursera.org/courses?query=descriptive%20statistics
5. https://www.coursera.org/lecture/linear-regression-model/correlation-QP6Mw

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	S	S	M	L	M
CO2	S	M	M	M	L	M	S	M	M	S
CO3	S	S	M	M	M	S	M	M	L	S
CO4	M	S	S	S	M	S	S	S	M	S
CO5	S	S	M	M	S	S	S	M	M	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: II **Paper type:** Core **Paper code:**

Name of the Paper: PROBABILITY AND RANDOM VARIABLES **Credits:** 4

Total Hours per Week: 5 **Lecture Hours:** 4 **Tutorial Hours:** 1 **Practical Hours:** -

……

Course Objectives

1. Learn the concept of random variables and probability
2. Knowledge to conceptualise the probabilities of events and the notion of conditional probability including the concept of Bayes' Theorem
3. Develop the concepts related to discrete and continuous random variables and their probability distributions including expectation
4. Understand the various types moment generating functions, skewness and Kurtosis
5. Study the basic discrete and continuous distribution functions with various properties

Course Outcomes

The student will be able to

1. Solve the problems related to random experiments
2. Comprehend the concepts of Baye's theorem applications
3. Explore the ideas of probability distributions
4. Derive the problems of moment generating function and computation of moments
5. Determine the bivariate distributions and related features

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	
2	✓	✓	✓	✓		✓
3	✓	✓		✓	✓	
4	✓			✓	✓	✓
5	✓	✓	✓	✓		

UNIT – I

Random experiment, sample point, sample space, event, algebra of events, operations on events. Classical and relative frequency approach to probability - axiomatic approach to probability. Simple problems.

UNIT – II

Addition theorem of probability, conditional probability, independence of events multiplication theorem - Bayes theorem and its applications.

UNIT – III

Definition of discrete and continuous random variables-Distribution functions - probability mass function, probability density functions and their properties. Expectation of random variables and its properties – Chebychev's inequality – simple problems.

UNIT – IV

Moment generating function, characteristic function, cumulant generating function - their properties, moments, measures of locations, dispersion, Skewness and Kurtosis for discrete and continuous variates. Simple problems.

UNIT – V

Bivariate distributions - discrete and continuous type, cumulative distribution function - probability mass function - probability density function - Marginal and Conditional expectation.

Text Books:

1. A.M.Mood, F.A. Graybill and D.C. Boes (1974): Introduction to the theory of Statistics, International student ed. McGraw Hill.
2. Hogg, R.V. and Craig, A.T. (1998): Introduction to Mathematical Statistics, 4th ed. Academic Press.
3. A.M.Goon, M.K.Gupta & B. Dasgupta (1980): An outline of Statistical theory, Vol. I, 6th revised, World Press.
4. Gupta, S.C. and V.K. Kapoor (2014): Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

Reference Books:

1. Rohatgi, V.K. (1984): An introduction to probability theory and mathematical statistics.
2. P.G.Hoel (1971): Introduction to Mathematical Statistics, Asia publishing house.
3. Murry R. Spiegal (1982): Theory and problems of Probability and Statistics, Schaum's outline series, McGraw Hill.
4. Seymour Lipshutz (1982): Theory and problems of probability, Schaum's outline series, McGraw Hill.
5. Marek Fisz (1961): Probability theory and Mathematical Statistics, John Wiley.
6. K.L.Chung (1983): Elementary probability theory with stochastic processes, Springer International student edition.
7. William.Feller (1968): An introduction to probability theory and its applications, Vol. I, 3rd ed., John Wiley & Sons.

Course Material: website links, e-Books and e-journals

1. **https://www.coursera.org/browse/data-science/probability-and-statistics**
2. **https://www.youtube.com/watch?v=sbbYntt5CJk**
3. **https://oli.cmu.edu/courses/probability-statistics-open-free/**
4. **https://www.classcentral.com/course/swayam-probability-and-statistics-5228**
5. **https://onlinecoursees ,swayam2,ac.in/cec21_ma09/preview**
6. **https://mathscs.clarku.edu/~hjoyee/ma217/moment,pdf**
7. **https://www.itl.nist,gov/div898/hadbook/eda/section3/eda36.htm**
8. **https://www.toppr.com/guides/fundamentals-of-business-mathematics-and-statistics/theoretical-distribution/theoretical-distribution/**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	S	S	S	M	S	M
CO2	M	S	S	S	S	S	M	M	S	M
CO3	S	M	S	M	M	S	M	S	M	M
CO4	S	M	M	L	M	M	M	S	M	M
CO5	M	M	M	M	S	S	M	M	M	M

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: II **Paper type:** Core Practical **Paper code:**

Name of the Paper: STATISTICAL PRACTICAL - I **Credits:** 4

Total Hours per Week: 3 **Lecture Hours:** - **Tutorial Hours:** - **Practical Hours:** 3

……

Course Objectives

1. Impart knowledge on statistical computation using real data sets
2. Instil knowledge to apply theory into practice
3. Understand the theory through practical oriented training
4. Explore the fundamental ideas of statistical problems
5. Execute the problems using appropriate statistical tools

Course Outcomes

The student will be able to

1. Construct frequency distributions and diagrammatic representations
2. Carry out measures of location, dispersion, skewness and kurtosis
3. Fit principle of least squares
4. Compute correlation and regression
5. Construct contingency table and association of attributes

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓		
2	✓	✓				
3	✓	✓	✓	✓	✓	✓
4	✓	✓	✓	✓		
5	✓	✓	✓	✓	✓	✓

Problems relating to the following topics which are covered in the core papers in the Semester I and Semester II shall form the basis for practical:

1. Construction of Uni-variate, bi-variate frequency distributions.
2. Diagrammatic and graphical representations, Ogives, Lorenz curves.
3. Measures of location and dispersion.
4. Measures of skewness and kurtosis for both grouped and ungrouped data. Measures of skewness and kurtosis using moments.
5. Principle of least squares and fittings of first, second degree and exponential curves.
6. Computation of correlation co-efficient. Rank correlation, and fitting regression equations.
7. Construction of contingency table. Association of Attributes.
8. Join Probability mass function, Join probability density function, Marginal probability mass and density functions. Expectation, variance and Correlation coefficient.

Text Books

Books prescribed in the respective core papers shall be used.

Note

The maximum marks for continuous internal assessment and end semester University examination for Statistical Practical-I shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test (25 marks) and record work (15

marks). The question paper at the end semester examination shall consist of **four questions with internal choice**. A candidate shall attend all the four questions, each of which shall carry 15 marks.

Course Material: website links, e-Books and e-journals

1. https://onlinecourses.nptel.ac.in/noc20_ma22/preview
2. https://archive.nptel.ac.in/content/storage2/courses/downloads_new/110107114/noc19_mg13_Assignment3.pdf
3. https://www.coursera.org/lecture/linear-regression-model/correlation-QP6Mw
4. https://online.stat.psu.edu/stat500/lesson/3/3.2/3.2.1

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	M	M	M	S	M	M	L
CO2	M	M	M	M	M	S	M	M	M	L
CO3	S	M	M	S	S	S	S	S	M	M
CO4	S	S	S	M	M	M	M	S	M	M
CO5	M	M	M	M	S	S	M	M	M	M

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: III **Paper type:** Core **Paper code:**

Name of the Paper: DISTRIBUTION THEORY **Credits:** 4

Total Hours per Week: 4 **Lecture Hours:** 3 **Tutorial Hours:** 1 **Practical Hours:** -

……

Course Objectives

1. Understand the concepts of probability distributions
2. Study essential properties of probability distributions
3. Impart the significance of correlation and regression
4. Comprehend the ideas of order statistics
5. Create and apply customized probability distributions

Course Outcomes

The student will be able to

1. Describe the fundamental concepts of probability distributions
2. Derive the properties of continuous probability distributions
3. Develop the properties of bivariate probability distributions
4. Find the existing theorems of probability distributions
5. Define order statistics and obtain their sampling distributions

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	
2	✓	✓	✓	✓	✓	
3	✓	✓		✓	✓	✓
4	✓	✓		✓	✓	✓
5	✓	✓	✓	✓	✓	✓

UNIT - I

Discrete distributions: Binomial, Trinomial and Multinomial distributions and their properties - Poisson, Negative Binomial and Geometric distributions and their properties.

UNIT - II

Continuous distributions: Normal, Uniform, Exponential, Gamma and Beta distributions and their properties.

UNIT - III

Bivariate Normal Distribution and its properties. Partial and multiple correlation and regression - Concepts and simple problems.

UNIT - IV

Basic Central Limit Theorem (statement only) - Limiting distributions : Poisson distribution as a limiting case of Binomial - Poisson distribution as a limiting case of Negative Binomial distribution - Convergence of Binomial, Poisson, Gamma and Chi-square distribution to Normal distribution using Moment generating function.

UNIT - V

Order statistics - distribution of first, n^{th} and i^{th} order statistics, joint distribution of r^{th} and s^{th} order statistics - distribution of median and range. Simple problems.

Text Books:

1. Gupta, S. C and Kapoor, V. K (2002), Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
2. Rohatgi, V. K (1976), Introduction to Probability Theory and Mathematical Statistics, John Wiley & Sons, Newyork.

Reference Books:

1. Hogg, R. V and Craig, A. T (2002), Introduction to Mathematical Statistics, Pearson Education Asia, India.
2. Lipschutz, S., Lipson, M. L. and Jain, K. (2010). Schaum's Outline of Probability, Second Edition, McGraw Hill Education Pvt. Ltd., New Delhi.
3. Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. New Delhi.
4. Johnson, S. and Kotz, S. (1972). Distribution in Statistics Vol. I-II & III, Houghton and Mifflin.

Course Material: website links, e-Books and e-journals

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/introduction-distribution-theory
4. https://www.coursera.org/courses?query=probability%20distribution

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	M	M	L	L
CO2	S	S	S	S	S	M	M	M	M	L
CO3	S	S	S	M	M	M	M	L	L	L
CO4	S	S	S	S	S	S	M	M	M	M
CO5	S	S	S	S	M	S	M	M	M	M

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: IV **Paper type:** Core **Paper code:**

Name of the Paper: SAMPLING THEORY **Credits:** 4

Total Hours per Week: 4 **Lecture Hours:** 3 **Tutorial Hours:** 1 **Practical Hours:** -

……

Course Objectives

1. Impart the significance of theory and applications of sampling
2. Enhance the ability of deriving the properties of methods of drawing samples
3. Comprehend the concepts of sampling for effective application for designing sample surveys
4. Create and apply sampling techniques
5. Develop the applications of sampling and their methods

Course Outcomes

The student will be able to

1. Understand the importance of sampling and sampling surveys
2. Adopt suitable sampling methods for given situations
3. Observe the effectiveness of sample surveys
4. Design and perform sample surveys
5. Draw random samples using various sampling methods and study the properties

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	
2	✓	✓	✓	✓		✓
3	✓	✓	✓	✓	✓	✓
4	✓	✓	✓	✓	✓	✓
5	✓	✓	✓	✓		✓

UNIT - 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 complete census - limitations of sampling.

UNIT - II

Sampling from finite population - simple random sampling with and without replacement - unbiased estimate of the mean, variance of the estimate of the mean finite population correction estimation of standard error from a sample - determination of sample size.

UNIT - 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 - estimation of gain in precision in stratified sampling.

UNIT - IV

Systematic sampling - estimate of mean and variance of the estimated mean - comparison of simple and stratified with systematic random sampling.

UNIT - V

Ratio estimators: Ratio estimates, variance of the ratio estimates - Bias of the ratio estimates. Regression estimators: Linear regression estimate regression estimates with pre-assigned b-regression estimates when b is computed from the sample.

Text Books:

1. William, G. Cochran (1984): Sampling techniques, Wiley Eastern.
2. Daroga Singh & Chaudhary, F.S. (1986): Theory and Analysis of Sample Survey Designs. Wiley Eastern.

Reference Books:

1. Des Raj (1976): Sampling theory, Tata McGraw Hill.
2. Sukhatme P.V. et al (1984): Sample survey methods and its applications, Indian Society of Agricultural Statistics, New Delhi.
3. Murthy, M.N. (1967): Sampling theory and methods, Statistical Publishing Society, Calcutta.
4. Sampath S. (1999): Sampling theory and methods. New Age International Ltd.
5. Engineering Updates.
6. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of applied statistics, Sultan Chand & Sons.

Course Material: website links, e-Books and e-journals

1. https://archive.nptel.ac.in/content/syllabus_pdf/111104073.pdf
2. https://www.mygreatlearning.com/blog/introduction-to-sampling-techniques/?amp
3. https://home.iitk.ac.in/~shalab/course1.htm

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	M	M	L	L
CO2	S	S	S	S	S	S	M	M	M	M
CO3	S	S	S	S	S	S	M	L	M	L
CO4	S	S	S	S	S	S	S	M	M	M
CO5	S	S	S	S	S	L	M	M	M	M

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: IV **Paper type:** Core Practical **Paper code:**

Name of the Paper: STATISTICAL PRACTICAL - II **Credits:** 4

Total Hours per Week: 4 **Lecture Hours:** - **Tutorial Hours:** - **Practical Hours:** 4

……

Course Objectives

1. Understand probability distributions and concepts
2. Fit the various distribution models like Binomial, Poisson and Normal
3. Compute Correlation and regression
4. Find population mean and variance for Simple, Stratified and systematic random sampling
5. Define ratio and regression estimators

Course Outcomes

The student will be able to

1. Solve the problems using the concept of probability distributions
2. Fit distribution models
3. Compute correlation coeffcients
4. Find population mean and variance under various sampling procedures
5. Apply ratio and regression estimators

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓		
3	✓	✓	✓	✓	✓	✓
4	✓	✓	✓	✓		
5	✓	✓	✓	✓	✓	✓

Problems relating to the following topics which are covered in Semester III and Semester IV shall form the basis for practical:

1. Distribution Theory (problems related to fitting of various distributions such as binomial, poison, normal, computation of correlation, partial and multiple correlation coefficients)
2. Sampling Theory (problems related to estimates of population mean and variances, under simple random sampling, stratified random sampling, systematic random sampling, ration and regression estimators)

Text Books

Books prescribed in the respective core papers shall be used.

Note

The maximum marks for continuous internal assessment and end semester University examination for Statistical Practical-II shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test (25 marks) and record work (15 marks). The question paper at the end semester examination shall consist of **four questions with internal choice**. A candidate shall attend all the four questions, each of which shall carry 15 marks.

Course Material: website links, e-Books and e-journals

1. https://swayam.gov.in/nd2_cec20_ma01/preview
2. https://nptel.ac.in/courses/111/104/111104032/
3. https://archive.nptel.ac.in/content/syllabus_pdf/111104073.pdf
4. https://www.mygreatlearning.com/blog/introduction-to-sampling-techniques/?amp
5. https://home.iitk.ac.in/~shalab/course1.htm

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	M	M
CO2	S	S	S	S	M	M	M	L	L	L
CO3	S	S	S	S	M	S	S	M	M	L
CO4	S	S	S	S	M	S	S	M	M	L
CO5	S	S	S	S	S	S	M	M	L	L

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: V **Paper type:** Core **Paper code:**

Name of the Paper: ESTIMATION THEORY **Credits:** 4

Total Hours per Week: 6 **Lecture Hours:** 4 **Tutorial Hours:** 1 **Practical Hours:** 1

……

Course Objectives

1. Understand and apply various estimation procedures
2. Knowledge about important inferential aspects such as point estimation and associated concepts
3. Study essential properties of a good estimator and related theorems
4. Explore the various methods of estimation
5. Comprehend the concepts of interval estimation

Course Outcomes

The student will be able to

1. Inculcate sampling distributions and its applications and various estimation procedure
2. Develop point estimation based problems
3. Identify a good estimator related to theorems
4. Solve various methods of estimation problems
5. Compute confidence interval problems for probability distributions

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓			✓
2	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	✓
4	✓	✓	✓	✓	✓	✓
5	✓	✓	✓	✓	✓	✓

UNIT - I

Sampling distributions - concept - distributions of mean and variance from Normal population. Sampling distributions: Chi-square, Student's t and F distributions - Derivation of their density functions and their properties

UNIT - II

Point Estimation - Problem of Point estimation - Properties of estimators - Consistency and Efficiency of an estimator. Sufficiency of a statistic - Neyman - Fisher factorization theorem (discrete case) - Simple problems.

UNIT - III

Unbiasedness - Properties, MVUE, BLUE, Rao - Blackwell theorem-Sufficiency and completeness, Lehman - Scheffe theorem, Cramer - Rao inequality - simple problems.

UNIT - IV

Methods of estimation: Method of Moments, Method of Maximum Likelihood, Method of minimum chi-square, Method of modified minimum chi-square, method of least squares - properties of estimators obtained by these methods - simple problems.

UNIT - V

Interval Estimation - Confidence Interval for proportions, mean(s), variance, and variance ratio based on chi square, student's t, F and Normal distributions. Tests of significance: concepts - tests based on normal, t, F, and Chi Square.

Text Books:

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. (1972): 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.
4. Gupta, S.C. and Kapoor, V.K. (2014): Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

Reference Books:

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. Marek Fisz (1961): Probability theory and Mathematical statistics, John Wiley.
5. Spiegal, M.R. (1982): Theory and problems of probability and statistics, Schaum's outline series, McGraw Hill
6. Snedecor, G.W. and Cochran, W.G. (1967): Statistical methods 6th edition, Oxford IBH Publishing Co.
7. Wilks, S.S. (1962): Mathematical statistics - John Wiley & Sons.

Course Material: website links, e-Books and e-journals

1. https://stattrek.com
2. https://www.coursera.org/lecture/stanford-statistics/the-sampling-distribution-isprR
3. https://www.youtube.com/watch?v=JmnmZB5VcyE

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	M
CO2	S	S	M	M	S	M	S	L	M	M
CO3	M	M	S	S	S	M	S	S	M	M
CO4	S	S	M	L	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: V **Paper type:** Core **Paper code:**

Name of the Paper: STATISTICAL QUALITY CONTROL **Credits:** 4

Total Hours per Week: 5 **Lecture Hours:** 3 **Tutorial Hours:** 1 **Practical Hours:** 1

……

Course Objectives

1. Understand the need of statistical quality control techniques
2. Impart the knowledge on control charts for variables and its applications in industries
3. Impart the knowledge on control charts for attributes and its applications in industries
4. Study the acceptance sampling plans for attributes
5. Inculcate the deep knowledge in the concept of variable sampling plans and it features.

Course Outcomes

The student will be able to

1. Construct control charts for process parameters
2. Effectively interpret the results from the control chart for variables
3. Carry out the results from the control chart for attributes
4. Adopt appropriate acceptance sampling plans for attributes
5. Find the applications of variable sampling plans

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓			
2	✓	✓	✓			
3	✓	✓	✓	✓	✓	✓
4	✓	✓	✓	✓	✓	✓
5	✓	✓	✓	✓	✓	✓

UNIT - I

Need for Statistical Quality Control techniques in Industry - Causes of Quality variation control charts - Use of the Shewhart - control chart - Specification and tolerance limits - 3 sigma limits - warning limits - application of theory of runs in quality control.

UNIT - II

Control chart for variables - X-bar chart, R chart, σ chart - purpose of the charts - Basis of sub grouping - plotting X-bar and R results - determining the trial control limits - Interpretation of control charts X-bar and R.

UNIT - III

Control chart for attributes - purpose of the chart - p chart - np chart - construction of p and np chart - choice between chart for P and chart for np - construction of c-chart.

UNIT - IV

Acceptance of sampling plans for attributes - Producer's risk and consumer's risk - concepts of AQL, LTPD, AOQ, AOQL, ATI and ASN - single, double and Multiples sampling plans - OC, AOQ, ATI curves for single and double sampling plans.

UNIT - V

Variable sampling plans - Sigma known and sigma unknown determination of n and k for one sided specification - OC curve.

Text Books:

1. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of applied statistics, Sultan Chand & Sons.
2. Montgomery, D.C. (1983): Introduction to Statistical Quality Control, John Wiley & Sons.

Reference Books:

1. Grant, E,L. and Laven Worth, R.S.: Statistical Quality Control, McGraw Hill.
2. Ekambaram, S K. (1963): Statistical basis of Acceptance sampling, Asia Publishing House.
3. Duncan, A. J. (2003.). Quality Control and Industrial Statistics, Irwin-Illinois, US.
4. Zacks, S.(1992). Introduction to Reliability Analysis: Probability Models and StatisticalMethods, Springer, New York.
5. Murthy, M.N. (1989): Excellence through Quality & Reliability, Applied statistical centre.

Course Material: website links, e-Books and e-journals

1. https://www.udemy.com/course/statistical-quality-control-sqc
2. https://engineering.purdue.edu/online/courses/stat-quality-control
3. https://nptel.ac.in/courses/116/102/116102019/

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	M
CO2	S	S	M	M	S	M	S	L	M	M
CO3	M	M	S	S	S	M	S	S	M	M
CO4	S	S	M	L	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: V **Paper type:** Core **Paper code:**

Name of the Paper: OPERATIONS RESEARCH **Credits:** 4

Total Hours per Week: 5 **Lecture Hours:** 4 **Tutorial Hours:** 1 **Practical Hours:** -

……

Course Objectives

1. Understand the importance of optimization techniques
2. Obtain the optimal solution for linear programming problems
3. Solve transportation and assignment problems
4. Formation and solving game theory and sequencing problems
5. Evaluate critical path method of solving network problems

Course Outcomes

The student will be able to

1. Formulate and solve the optimization problem
2. Solve linear programming problems
3. Explore and address transportation and assignment problems
4. Develop game theory and sequencing problems
5. Determine critical path method of solving network problems

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	✓
2	✓	✓	✓			✓
3	✓	✓	✓	✓	✓	✓
4	✓	✓	✓	✓	✓	✓
5	✓	✓	✓	✓	✓	✓

UNIT - I

Introduction to OR, Nature, Scope, Functions, Linear programming problem - Formulation of LPP - Solving the LPP by graphical method.

UNIT - II

Slack variable - surplus variable - Solving the LPP by simplex method - artificial variable - Big-M method, Duality in LPP, Dual simplex method.

UNIT - III

Transportation problem - obtaining initial, feasible and optimal solutions. Optimality test degeneracy, Unbalanced transportation problem, Assignment problem, and unbalanced assignment problem - Traveling salesman problem.

UNIT - 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.

UNIT - V

Network analysis by CPM / PERT basic concepts - constraints in Network - construction of the network - Time calculations - Concepts of three floats in Network Analysis - finding optimum project duration and minimum project cost, finding expected project time and variance.

Text Books:

1. Kanti Swamp et al: Operations Research, sutan chand and Sons, New Delhi.
2. Sharma J.K. (2001): Operations Research. Theory and applications, Macmillan India Ltd.

Reference Books:

1. Handy A. Taha (1996): Operations Research, 6 ed. Prentice Hall of India
2. Goel & Mittal (1982): Operations Research, Pragati Prakashan, Meerut.
3. Gupta R.K.(1985): Operations Research, Krishna Prakashan, Mandir, Meerut.
4. Schaum's outline series: Operations Research.
5. Frederick S.Hillier & Gerald J.Lieberman: (1987) Operations Research, CBS publishers & Distributors, Delhi.
6. Sharma J.K. (2002): Operations Research. Problems and solutions, Macmillan India Ltd.

Course Material: website links, e-Books and e-journals

1. https://swayam.gov.in/nd2_cec20_ma10/preview
2. https://swayam.gov.in/nd1_noc19_ma29/preview
3. https://nptel.ac.in/courses/112/106/112106131/
4. https://nptel.ac.in/courses/112/106/112106134/

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	M
CO2	S	S	M	M	S	M	S	L	M	M
CO3	M	M	S	S	S	M	S	S	M	M
CO4	S	S	M	L	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: V **Paper type:** Core **Paper code:**

Name of the Paper: APPLIED STATISTICS **Credits:** 4

Total Hours per Week: 5 **Lecture Hours:** 3 **Tutorial Hours:** 1 **Practical Hours:** 1

……

Course Objectives

1. Understand the significance of time series and its components
2. Explore the various methods related to measuring seasonal variations in the data
3. Comprehend the concepts of Index numbers and its usage
4. Develop the cost of living index and its applications
5. Study the deep knowledge of theory and applications of demand analysis

Course Outcomes

The student will be able to

1. Create time series models for the given data
2. Design the seasonal variations in data
3. Determine the applications of Index numbers
4. Find the cost of living Index numbers
5. Know the theory and applications of demand analysis

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓		
2	✓	✓	✓		✓	✓
3	✓	✓	✓	✓		✓
4	✓	✓	✓	✓	✓	✓
5	✓	✓	✓	✓	✓	✓

UNIT - I

Time series - Concept - Components of time Series - Additive and multiplicative models - Measurement of trend - free hand method - semi average method - Moving average method - Least square method.

UNIT - II

Measurement of seasonal variations - Simple average method - Ratio to trend method - Ratio to moving average method - Link relative method - Variate Difference method.

UNIT - III

Index Numbers - uses - classification of index numbers - Problems in the construction of index numbers - Methods of constructing index numbers - Unweighted index numbers - weighted index numbers.

UNIT - IV

Quantity index numbers - Fixed and chain base index numbers - Optimum test for index numbers - Time reversal test - factor reversal test - cost of living index numbers.

UNIT - V

Demand Analysis Theory and analysis of consumer's demand Law of demand, Price elasticity of demand estimation of demand curves forms of demand functions - Demand and Supply utility and indifference maps determination of price and supply and demand

Text Books:

1. Kapoor,V.K and Gupta,S.C (1978); Fundamentals of Applied Statistics, Sultan chand & Sons.
2. Mukhopadhyay P.(1999): Applied Statistics, New Central Book Agency Pvt. Ltd., Calcutta.

Reference Books:

1. Gupta, S.P (1999): Statistical Methods, Sultan & Sons, New Delhi.
2. Croxton, F.E & Cowdon, D.J. (1973): Applied general statistics, Prentice Hall
3. Srinivasan, K. (1998). Demographic Techniques and Applications. Sage Publications.
4. Srivastava O.S. (1983). A Text Book of Demography. Vikas Publishing House.

Course Material: website links, e-Books and e-journals

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. http://ocw.jhsph.edu/courses/demographicmethods/PDFs/idm-sec1.pdf

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	M
CO2	S	S	M	M	S	M	S	L	M	M
CO3	M	M	S	S	S	M	S	S	M	M
CO4	S	S	M	L	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: VI **Paper type:** Core **Paper code:**

Name of the Paper: TESTING STATISTICAL HYPOTHESES **Credits:** 4

Total Hours per Week: 5 **Lecture Hours:** 3 **Tutorial Hours:** 1 **Practical Hours:** 1

……

Course Objectives

1. Understand the concepts of Type I error, Type II Error and Power of the Test
2. Compute the Critical Region for testing the hypothesis by Likelihood ratio Method
3. Comprehend the ideas of Sequential Probability Ratio Test
4. Calculate the Non parametric Tests
5. Develop deep knowledge in the concepts of Risk Function and Loss Function

Course Outcomes

The student will be able to

1. Compute power of test for testing any Statistical Hypothesis
2. Calculate the Critical Region by using the concept Likelihood Ratio criterion
3. Construct the Sequential probability ratio Test for testing any statistical hypothesis
4. Interpret the results of Non-Parametric Test
5. Have an idea about the concept of Risk and Loss Function

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓		✓	
2	✓	✓	✓			✓
3	✓	✓	✓	✓		
4	✓	✓	✓	✓		
5	✓	✓	✓	✓	✓	✓

UNIT - I

Testing of Hypothesis - Statistical Hypothesis - Simple and composite hypothesis, Null and Alternative Hypothesis - Two types of errors - critical region- powers of a test - Most powerful test - Neyman-Pearson lemma.

UNIT - II

Uniformly most powerful tests, Likelihood ratio criterion - Definition and test for means and variance (one sample only).

UNIT - III

Sequential Probability Ratio Test - Definition - properties - Wald's equation - construction of SPRT - binomial - poisson - normal distributions - OC and ASN computations.

UNIT - IV

Non-parametric tests - Run, Median, sign and Mann Whitney tests (one sample and two sample) problems. Wilcoxon Signed rank test, test sum test, Kolmogorov's Smirnov one sample test and Kruskal Wallis test.

UNIT - V

Basic ideas on decision theory - Loss functions - Risk functions - Prior distributions - Bayes Risk - Simple problems based on Bayes estimation and testing.

Text Books:

1. Mood, A.M. Graybill, F.A. and Boes, D.C. (1974): Introduction to the theory of Statistics, McGraw Hill.
2. Rohatgi, V.K. (1984) An introduction to probability theory and mathematical statistics, Wiley Eastern.
3. Gupta, S.C. and Kapoor, V.K.(2004): Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
4. Hogg R.V.and Craig, A.T. (1972): Introduction to mathematical statistics, 3rd edition, Academic Press, USA.
5. 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.

Reference Books:

1. Rajagopalan, M., and Dhanavanthan, P. (2012). Statistical Inference, PHI Learning Pvt., Ltd., New Delhi.
2. Hood, P.G. (1971): Introduction to mathematical statistics, Asia publishing house.
3. Marek Fisz (1961): Probability theory and Mathematical statistics, John Wiley.
4. Spiegal,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
6. Lehmann, E. L. (1986). Testing Statistical Hypotheses, Second Edition, John Wiley & Sons, NY.

Course Material: website links, e-Books and e-journals

1. https://online.stat.psu.edu/stat415/lesson/26/26.2
2. https://www.statisticshowto.com
3. https://www.coursera.org/learn/statistical-inference
4. https://onlinecourses.nptel.ac.in/noc20_ma19/preview

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	M
CO2	S	S	M	M	S	M	S	L	M	M
CO3	M	M	S	S	S	M	S	S	M	M
CO4	S	S	M	L	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: VI **Paper type:** Core **Paper code:**

Name of the Paper: DESIGN OF EXPERIMENTS **Credits:** 4

Total Hours per Week: 5 **Lecture Hours:** 3 **Tutorial Hours:** 1 **Practical Hours:** 1

……

Course Objectives

1. Understand the fundamental concept of Principle of Design of Experiments
2. Explore knowledge in the Analysis of Variance and its applications
3. Construct the ANOVA Table for various Experimental Design
4. Estimate the Missing observations in various Experimental Design
5. Get a knowledge on factorial Experiment and Confounding

Course Outcomes

The student will be able to

1. Construct ANOVA Table for One way and Two way Classifications
2. Analyse ANOVA for various Experimental Designs
3. Calculate the Missing observations for various Experimental Designs
4. Have an idea about the Split Plot Designs
5. Frame ANOVA Table for Factorial Experimental Designs

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓			
2	✓	✓	✓		✓	✓
3	✓	✓	✓	✓		
4	✓	✓	✓	✓		
5	✓	✓	✓	✓	✓	✓

UNIT - I

Fundamental Principles of Experiments - Replication, Randomization and Local Control Techniques - Experimental errors - Uniformity trails - Size of experimental unit - Methods of determination of experimental units - (Maximum curvature method-Fairfield Smith's variance law).

UNIT - 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-Need for transformations Square root, angular and log transformations.

UNIT - III

Completely Randomized Design (CRD) and its analysis - Randomized Block Design (RBD) and its analysis - Latin Square Design(LSD) and its analysis - Merits and demerits of CRD, RBD and LSD.

UNIT - IV

Missing plot technique - Meaning - Least square method of estimating missing Observations - one and two observations missing in RBD and LSD - Analysis of covariance technique in CRD and RBD(without derivation) - concept of Split-plot design

UNIT - V

Factorial experiments - Definition 2^2, 2^3 and 3^2 factorial experiments and their analysis - Analysis of BIBD and parametric Relations - concept of confounding and its merits.

Text Books:

1. Das M.N and Giri N.C (1986) Design and Analysis of Experiments, Wiley Eastern, New Delhi.
2. Gupta, S.P. and Kapoor, V.K. (1978): Fundamentals of Applied Statistics, Sultan Chand & Sons.
3. Panneerselvam, R. (2012): Design and Analysis of Experiments, PHI.

Reference Books:

1. Rangaswamy, R (2014). Text book of Agricultural Statistics, New Age publishers
2. Montgomery, D (1972) Design of Experiments, John Wiley and Sons
3. Kempthorne, (1956) Design and Analysis of Experiments, John Wiley. New York.
4. Mukhopadhaya, P, (2011), Applied Statistics, Books & Allied Ltd, 2nd edition.
5. Cochran, W. G and Cox, G. M. (1957), Experimental Design, John Wiley & Sons, New York

Course Material: website links, e-Books and e-journals

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	M
CO2	S	S	M	M	S	M	S	L	M	M
CO3	M	M	S	S	S	M	S	S	M	M
CO4	S	S	M	L	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: VI **Paper type:** Core **Paper code:**

Name of the Paper: STOCHASTIC PROCESSES **Credits:** 4

Total Hours per Week: 4 **Lecture Hours:** 3 **Tutorial Hours:** 1 **Practical Hours:** -

……

Course Objectives

1. Understand the fundamental concepts of random processes and its characteristics
2. Study the Chapman-Kolmogrov equation and its applications
3. Compute transition probability matrix and its long run distribution
4. Review the various models of Stochastic processes
5. Enhance the concept of branching Processes and probability generating Function

Course Outcomes

The student will be able to

1. Promote ideas about random processes and its classification
2. Develop Markov chain and its applications
3. Impart the significance of limiting distribution of transition probability
4. Inculcate deep knowledge in Poisson process and its applications
5. Acquire to know the concept of branching processes

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓		✓		
2	✓	✓	✓		✓	✓
3	✓	✓	✓	✓		
4	✓	✓	✓	✓		
5	✓	✓	✓	✓		✓

UNIT - 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.

UNIT - II

Markov chains: Definition and examples of Markov chain, Transition Probability Matrix, classification of states, recurrence, simple problems

UNIT - III

Basic limit theorem of Markov chain (statement only), stationary probability distribution, applications.

UNIT - IV

Continuous Time Markov chain: Pure birth process and Poisson process, Birth and Death process, problems.

UNIT - V

Branching process: Definition and examples of discrete time branching process, probability generating function, mean and variance, probability of extinction, simple problems.

Text Books:

1. Medhi, J. (1996): Stochastic processes, New Age International (p) Ltd.
2. Karlin, S. and Taylor, H.M. (1975): A first course in Stochastic processes, Academic press.

Reference Books:

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.
3. Cinlar, B. (1975) Introduction to Stochastic processes, Prentice Hall.
4. Adke, S.R. and Manjunath, S.M. (1984): An introduction to Finite Markov Processes, Wiley Eastern.
5. Ross, S.M. (1983): Stochastic processes, John Wiley.

Course Material: website links, e-Books and e-journals

1. https://nptel.ac.in/courses/111/103/111103022/
2. https://nptel.ac.in/courses/111/102/111102098/
3. https://www.stat.auckland.ac.nz/~fewster/325/notes/325book.pdf
4. https://ocw.mit.edu/courses/mathematics/18-445-introduction-to-stochastic-processes-spring-2015/lecture-notes/

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	M
CO2	S	S	M	M	S	M	S	L	M	M
CO3	M	M	S	S	S	M	S	S	M	M
CO4	S	S	M	L	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: VI **Paper type:** Core Practical **Paper code:**

Name of the Paper: STATISTICAL PRACTICAL – III **Credits:** 4

Total Hours per Week: 3 **Lecture Hours:** - **Tutorial Hours:** - **Practical Hours:** 3

……

Course Objectives

1. Compute the confidence interval for different Parameters
2. Prepare control charts for variables and attributes
3. Calculate the various Test Statistics for different types of Testing Hypothesis
4. Analyse the various Non-Parametric Tests
5. Develop ANOVA Table for different experimental Designs

Course Outcomes

The student will be able to

1. Draw conclusion on the estimation of the Population Parameters
2. Study the variation of the different characteristics based on control chart
3. Draw inferences on the Population parameters based on Test Statistic
4. Know the preparation of ANOVA Table
5. Draw inference on the effect of various factors in the Experimental designs

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	
2	✓	✓	✓		✓	✓
3	✓	✓	✓	✓	✓	
4	✓	✓	✓	✓	✓	
5	✓	✓	✓	✓	✓	

Problems relating to the following topics which are covered in Semester V and Semester VI shall form the basis for practical:

1. **Estimation theory** (problems related to estimation of parameters under various methods, confidence intervals for mean, variance and proportions)
2. **Statistical Quality Control** (Control charts for variables and attributes).
3. **Testing of Statistical Hypotheses** (problem related to test of significance of mean, variances, one sample, two samples and more than two samples, Non-parametric tests)
4. **Design and Analysis of Experiments** (problem related to CRD, RBD, LSD, Missing Plot Techniques, Factorial experiments 2^3, 3^2 and BIBD)

Text Books

Books prescribed in the respective core papers shall be used.

Note

The maximum marks for continuous internal assessment and end semester University examination for Statistical Practical-III shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test (25 marks) and record work (15 marks).

The question paper at the end semester examination shall consist of **four questions with internal choice**. A candidate shall attend all the four questions, each of which shall carry 15 marks.

Course Material: website links, e-Books and e-journals

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://online.stat.psu.edu/stat415/lesson/26/26.2
4. https://www.statisticshowto.com

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	M	M	M	M
CO2	S	S	S	S	S	S	S	S	M	M
CO3	S	S	S	S	S	S	M	M	M	M
CO4	S	S	S	S	S	S	S	S	M	L
CO5	S	S	S	S	S	S	M	M	M	M

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: VI **Paper type:** Core Project **Paper code:**

Name of the Paper: PROJECT WITH VIVA-VOCE **Credits:** 4

Total Hours per Week: 5 **Lecture Hours:** - **Tutorial Hours:** 2 **Practical Hours:** 3

……

All the admitted candidates shall have to carry out a project work during the fourth semester under the supervision of the faculty of the Department of Statistics in the College. The core project may be individual / group project (Not exceeding five members in a group). Candidates shall have to submit three copies of the report of the project work at the end of the fourth semester at least two weeks before the last working day and shall have to appear for a viva-voce examination. The report shall be evaluated and viva-voce examination shall be conducted jointly by an External Examiner and the Project Guide. The maximum marks for the project report and viva – voce examination shall be fixed as 100, which is split with the following components:

Internal Assessment Marks by the Project/Dissertation Guide	:	25 marks
Evaluation of Project/Dissertation Report jointly by the External Examiner and the Guide	:	50 marks
Conduct of Viva-Voce Examination by the external examiner	:	25 marks

Semester: I **Paper type:** Allied **Paper code:**

Name of the Paper: MATHEMATICS - I **Credits:** 3

Total Hours per Week: 6 **Lecture Hours:** 5 **Tutorial Hours:** 1 **Practical Hours:** -

……

Course Objectives

1. Impart the understanding of partial fractions
2. Comprehend the concepts of various theory of equations
3. Study essential properties and theorems on matrices
4. Inculcate deep knowledge on trigonometric expansions
5. Acquire to know the concepts of differential calculus

Course Outcomes

The student will be able to

1. Compute the problems in partial fractions
2. Carry out results for theory of equations
3. Effectively interpret the results on matrices
4. Possess clear idea about trigonometric expansions
5. Understand the importance of differential calculus

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓			
2	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓	✓	
4	✓	✓	✓	✓	✓	
5	✓	✓	✓	✓	✓	✓

UNIT-I

Partial Fractions - Binomial, Exponential and logarithmic Series (without Proof) - Summation - Simple problems

UNIT-II

Polynomial Equations with real Coefficients - Irrational roots - Complex roots- Transformation of equation by increasing or decreasing roots by a constant - Reciprocal equations - Newton's method to find a root approximately - Simple problems.

UNIT-III

Symmetric - Skew-Symmetric - Orthogonal and Unitary matrices - Eigen roots and eigen vectors – Cayley - Hamilton theorem (without proof)-Verification and computation of inverse matrix

UNIT-IV

Expansions of $\sin^n \theta$, $\cos^n \theta$, $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ - Expansions of $\sin \theta$, $\cos \theta$, $\tan \theta$ in terms of θ.

UNIT-V

Successive differentiation upto third order, Jacobians -Concepts of polar co-ordinates-Curvature and radius of curvature in Cartesian co-ordinates and in polar co-ordinates.

Text Books:

1. P.Duraipandian and S.Udayabaskaran,(1997) *Allied Mathematics,* Vol. I & II, Muhil Publishers, Chennai.

Reference Books:

1. P.Balasubramanian and K.G.Subramanian,(1997) *Ancillary Mathematics.* Vol. I & II. Tata McGraw Hill, New Delhi.
2. S.P.Rajagopalan and R.Sattanathan,(2005) *Allied Mathematics* .Vol. I & II. VikasPublications, New Delhi.
3. P.R.Vittal (2003) *Allied Mathematics* .Marghan Publications, Chennai
4. P.Kandasamy, K.Thilagavathy (2003) Allied Mathematics Vol-I, II S.Chand& company Ltd., New Delhi-55.
5. Isaac, Allied Mathematics. New Gamma Publishing House, Palayamkottai.

Course Material: website links, e-Books and e-journals

1. https://www.youtube.com/watch?v=NIioymESlCo
2. https://www.youtube.com/watch?v=XIP0ulUajMM
3. https://www.youtube.com/watch?v=CFn3y0YKXk8
4. https://www.youtube.com/watch?v=Hb3keLcqc10

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	M	M	M	M
CO2	S	S	M	M	L	L	M	M	M	M
CO3	S	S	S	M	S	M	S	M	M	L
CO4	S	M	M	M	S	S	S	L	L	L
CO5	M	M	M	M	L	M	M	M	M	L

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: II **Paper type:** Allied **Paper code:**

Name of the Paper: MATHEMATICS - II **Credits:** 3

Total Hours per Week: 6 **Lecture Hours:** 5 **Tutorial Hours:** 1 **Practical Hours:** -

……

Course Objectives

1. Enhance the concepts of integrals and its applications
2. Study essential methods of partial differential equations
3. Explore the knowledge in laplace transforms
4. Develop clear idea on vector analysis
5. Promote vector analysis related theorems

Course Outcomes

The student will be able to

1. Solve integral based problems
2. Execute partial differential equations
3. Aquire ideas in laplace transforms
4. Inculcate practical knowledge in vector analysis
5. Attain to solve theorems in vector analysis

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓		
2	✓	✓		✓	✓	
3	✓	✓			✓	
4	✓	✓		✓	✓	
5	✓	✓	✓	✓	✓	✓

UNIT-I

Evaluation of double, triple integrals - Simple applications to area, volume -Fourier series for functions in $(0,2\pi)$ and $(-\pi,\pi)$

UNIT-II

Formation, complete integrals and general integrals - Four standard types, Lagrange's equations.

UNIT-III

Laplace Transformations of standard functions and simple properties - Inverse Laplace transforms - Applications to solutions of linear differential equations of order 1 and 2-simple problems

UNIT-IV

Scalar point functions - Vector point functions - Gradient, divergence, curl - Directional derivatives - Unit to normal to a surface.

UNIT-V

Line and surface integrals - Guass, Stoke's and Green's theorems (without proofs) - Simple problem based on these Theorems.

Text Books:

1. P.Duraipandian and S.Udayabaskaran,(1997) *Allied Mathematics*, Vol. I & II.Muhil Publishers, Chennai

Reference Books:

1. P.Balasubramanian and K.G.Subramanian,(1997)*Ancillary Mathematics*. Vol. I & II. Tata McGraw Hill, New Delhi.
2. S.P.Rajagopalan and R.Sattanathan,(2005) *Allied Mathematics* .Vol. I & II.Vikas Publications, New Delhi.
3. P.R.Vittal(2003). *Allied Mathematics* .Marghan Publications, Chennai.
4. P.Kandasamy, K.Thilagavathy (2003) Allied Mathematics Vol-I, II S.Chand& company Ltd., New Delhi-55.
5. Isaac, Allied Mathematics. New Gamma Publishing House, Palayamkottai

Course Material: website links, e-Books and e-journals

1. https://onlinecourses.nptel.ac.in/noc19_ma20/preview
2. https://onlinecourses.nptel.ac.in/noc22_ma03/preview
3. https://onlinecourses.nptel.ac.in/noc21_ma12/preview

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	L	L	L	M
CO2	S	S	M	M	M	M	M	M	L	L
CO3	S	M	M	L	L	M	M	L	M	M
CO4	S	M	M	M	M	M	M	M	L	M
CO5	S	S	M	M	M	M	M	M	M	L

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: III **Paper type: Allied** **Paper code:**

Name of the Paper: NUMERICAL METHODS **Credits: 3**

Total Hours per Week: 4 **Lecture Hours: 3** **Tutorial Hours: -** **Practical Hours: 1**

……

Course Objectives

1. Understand the functions of finite differences and related problems
2. Study the concepts of Interpolation with unequal intervals
3. Comprehend the ideas of central difference interpolation formula
4. Acquire to know the Inverse Interpolation problems
5. Inculcate knowledge in Numerical Integration

Course Outcomes

The student will be able to

1. Solve the finite differences related problems
2. Find the results of Interpolation with unequal interval problems
3. Calculate the central difference interpolation problems
4. Obtain Inverse Interpolation problems
5. Compute Numerical Integration

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	
2	✓	✓	✓	✓		✓
3	✓	✓	✓	✓	✓	
4	✓	✓	✓			✓
5	✓	✓	✓	✓	✓	✓

UNIT - I

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.

UNIT - II

Interpolation with unequal intervals: Divided differences and their properties, Newton's divided differences formula and Lagrange's formula for interpolation-simple problems.

UNIT - III

Central difference interpolation formula - gauss forward and backward differences formulae - Stirling, Bessel's Everett's central difference formula.

UNIT - IV

Inverse interpolation - Lagrange's method - iteration of successive approximation method-simple problems. Numerical differentiation - Numerical differentiation upto 2^{nd} order only - simple problems.

UNIT – V

Numerical intergration - Trapezoidal rule - simpson's $1/3^{rd}$ and $3/8^{th}$ rules - Weddle's rule -

Euler's summation formula. Numerical method of solution of ordinary differential equations - Taylor's series method - Euler method and Runga Kutta upto second order -simple problems.

Text Books:

1. Numerical Methods by P.Kandasamy,K.Thilagavathy and K.Gunavathi,S.Chand, New Delhi.
2. Numerical methods in Science and Engineering by M.K. Venkataraman, National publishing house, Chennai.

Reference Books:

1. Calculus of finite differences and Numerical analysis by Gupta-Malik, Krishna Prakastan Mandir, Meerut.
2. Numerical methods in Science and Engineering by M.K. Venkataraman, National publishing house, Chennai.
3. Numerical Analysis by B.D. Gupta, Konark publishing.
4. Calculus of finite differences and Numerical Analysis by Saxena, S. Chand & Co.
5. Numerical mathematics by M.M.Ramasamy and Palaniappan.
6. Introductory Methods of Numerical Analysis by S.S.Sastry,Printice Hall of India,New Delhi.

Course Material: website links, e-Books and e-journals

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	M	M	M	L
CO2	S	S	S	S	S	S	S	M	L	L
CO3	S	S	S	S	S	S	M	M	M	M
CO4	S	S	S	S	S	M	M	M	M	L
CO5	S	S	S	S	S	M	L	M	M	M

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: IV **Paper type:** Allied **Paper code:**

Name of the Paper: PROGRAMMING IN 'C' **Credits:** 3

Total Hours per Week: 3 **Lecture Hours:** 2 **Tutorial Hours:** - **Practical Hours:** 1

……

Course Objectives

1. Understand the Programming language
2. Develop skills to write codes in C language
3. Study an understanding of the compilation process
4. Create skills to design programs using a variety of data structures
5. Write and develop new algorithms

Course Outcomes

The student will be able to

1. Write inline functions for efficiency and performance
2. Overload functions and operators in C
3. Design and implement generic classes with C templates
4. Develop C classes for code reuse
5. Identify syntax and semantics of the C programming language

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓			
2	✓	✓	✓			
3	✓	✓	✓	✓		✓
4	✓	✓	✓	✓	✓	✓
5	✓	✓	✓		✓	✓

UNIT - I

Introduction to "C", variables, data types-declarations, type conversions, increment and decrement, Bitwise, Logical and Assignment operators.

UNIT - II

Expression and conditional expressions, control structures, If-Else, SWITCH, WHILE, FOR and DO WHILE loop structures. Break continue, GO and Label statements. Function, function returning, Non-integers, Function arguments -Static and register variables.

UNIT - III

Arrays and Strings - Array Declaration, Multi dimensional Arrays Strings/Character Arrays, Array initialization-Pointers and addresses. Pointers and Arrays-Pointer to function.

UNIT - IV

Structures and functions, Array of structures Fields, Unions-type definition standard input and output - formatted output - output - Access to the standard library.

UNIT - V

File Access, File handling in C - File descriptions - Error handling - 'Low level i/o-Read and Write'. Open, Create, Close, Unlike-Random Access - seek and I seek.

Text Books:

1. Balagurusamy, E. (1997): ANSI 'C' Programming, Tata-McGraw Hill Publishers Ltd.

Reference Books:

1. Gottfried B. S. (1996). Theory and problems of Programming with C. 2nd edition, McGraw Hill.
2. Schildt, H. (1985). C Made Easy. McGraw Hill.
3. Schildt, H. (2010). C The Complete Reference, 3rd Edition, McGraw Hill.
4. Yaswant Kanetkar (1997): Let Us 'C',BPB Publications, New Delhi.

Course Material: website links, e-Books and e-journals

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
2. https://onlinecourses.nptel.ac.in/noc19_cs42/preview
3. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
4. https://archive.nptel.ac.in/courses/106/104/106104128/

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	M	M	L	L
CO2	S	S	S	S	S	M	M	M	M	M
CO3	S	S	S	S	M	L	M	M	L	L
CO4	S	S	S	S	M	M	M	M	L	M
CO5	S	S	S	S	S	L	M	M	L	L

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: IV **Paper type:** Allied Practical **Paper code:**

Name of the Paper: NUMERICAL METHODS AND PROGRAMMING IN C **Credits:** 2

Total Hours per Week: 3 **Lecture Hours:** - **Tutorial Hours:** - **Practical Hours:** 3

……

Course Objectives

1. Understand Summation of Series and String Manipulation
2. Know about Solution of polynomial equation and system of simultaneous equation
3. Comprehend Interpolation and Numerical integration
4. Check the accuracy of the built in functions and Generation of Fibonacci Sequence
5. Compute Matrix addition, multiplication, inverse and transpose

Course Outcomes

The student will be able to write programs to

1. Find Summation of Series and String Manipulation
2. Determint the solution of polynomial equation and system of simultaneous equation
3. Calculate Interpolation and Numerical integration
4. Check the accuracy of the built in functions and Generation of Fibonacci Sequence
5. Calculate Matrix addition, multiplication, inverse and transpose

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓		✓
4	✓	✓	✓	✓	✓	
5	✓	✓	✓	✓		✓

Problems relating to the following topics which are covered in Allied papers of Semester III and Semester IV shall form the basis for practical:

1. Summation of Series: Sin(x), Cos(x), Exp(x), (Comparison with built in functions)
2. String Manipulation: Counting the no. of vowels, consonants, words, white spaces in a line of text and array of lines. Reverse a string & check for palindrome. Substring detection, count and removal - Finding and replacing substrings
3. Solution of polynomial equation - Newton Raphson method
4. Solution of system of simultaneous equation - Gauss elimination method.
5. Interpolation - Lagrange interpolation.
6. Numerical integration by Trapezoidal, Simpson's and Weddle's rules - Calculate the value of π (up to five decimal places).
7. Check the accuracy of the built in functions Sin(x), Cos(x),(x in radians) e^{x}, e^{-x} Generation of Fibonacci Sequence.
8. Matrix addition, multiplication, inverse, transpose, determinant of square matrix. Solution of simultaneous equations by Iterative methods and by using inverse.

Text Books

Books as prescribed in Allied papers in the semester III and IV.

Note

The maximum marks for continuous internal assessment and end semester University examination for Allied Practical-I shall be fixed as 40 and 60, respectively. The continuous internal assessment shall involve test (25 marks) and record work (15 marks). The question paper at the end semester examination shall consist of **four questions with internal choice**. A candidate shall attend all the four questions, each of which shall carry 15 marks.

Course Material: website links, e-Books and e-journals

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
2. https://onlinecourses.nptel.ac.in/noc19_cs42/preview
3. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
4. https://archive.nptel.ac.in/courses/106/104/106104128/
5. https://onlinecourses.nptel.ac.in/noc21_ma45/preview
6. https://archive.nptel.ac.in/courses/111/107/111107105/

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	M	M	M	M
CO2	S	S	S	S	S	S	S	M	M	M
CO3	S	S	S	S	S	M	S	S	S	M
CO4	S	S	S	S	S	S	M	M	M	L
CO5	S	S	S	S	S	M	S	S	M	L

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: V **Paper type:** Internal Elective **Paper code:**

Name of the Paper: DEMOGRAPHY **Credits:** 3

Total Hours per Week: 4 **Lecture Hours:** 3 **Tutorial Hours:** 1 **Practical Hours:** -

……

Course Objectives

1. Study the fundamental concepts of demography and its sources
2. Understanding the function to compute the mortality rates and its variants
3. Review the significance of fertility rates and its variants
4. Enhance the construction of life tables
5. Impart the significance of statistical tools for projection of populations

Course Outcomes

The student will be able to

1. Apply the concepts of demography
2. Computational aspects of mortality rates and its variants
3. Analyse the results of fertility rates and its variants
4. Construct life tables and applications
5. Create and explore the projection of populations

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	
2	✓	✓	✓			
3	✓	✓	✓	✓	✓	
4	✓	✓	✓	✓	✓	
5	✓	✓	✓	✓	✓	

UNIT - I

Sources of Demographic data - Civil Registration - Population Census - Population Registers - Errors in Demographic data - Methods of Improvement.

UNIT - II

Mortality measurements - Merits and Demerits - general and specific rates - standardized rates - age pyramid of sex composition - Ratios, propositions and percentage rates - Population pyramids, sex ratio, crude rate, specific rates, standard rates - direct and indirect.

UNIT - III

Fertility, Measures of fertility, General fertility rate, Specific fertility rate, Net reproduction rate, Gross reproduction rate, Crude Rate of natural increase. Definition - stable population and stationery population.

UNIT - IV

Life table - Structure - Construction and uses - Relationship between functions of the life table - abridged life table (Concept only)

UNIT – V

Population estimation and projection, component method of population projection Forces of mortality - Gompertz and Makcham law logistic curve fitting and its use.

Text Books:

1. Srivastava, O.S (1983): A text book Demography, Vikas Publishing
2. Bogue, Donald, J (1976): Principles of Demography, John Wiley, New York.
3. Gupta, S.C. and V.K. Kapoor (1978): Fundamentals of Applied Statistics, Sultan Chand & Sons.
4. Mukhopadhyay, P. (2011): Applied Statistics, Second Edition, Books and Allied (P) Ltd., India.

Reference Books:

1. Spieglemen, M.(1968): Introduction to Demography, Harvard University Press.
2. Mishra, B. D. (1980). An Introduction to the Study of Population, South Asian Publishers Pvt. Ltd., New Delhi.
3. Barclay, G. W. (1958). Techniques of Population Analysis, John Wiley and Sons, New York

Course Material: website links, e-Books and e-journals

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=AIpkMAwQpWc
4. https://www.youtube.com/watch?v=_gy3IZ2FBuI
5. https://www.youtube.com/watch?v=ZArGanRzyT8

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	S	S	M	M
CO2	M	M	M	M	M	M	S	L	M	M
CO3	M	M	S	S	M	M	S	S	M	M
CO4	S	S	M	L	M	S	M	S	S	S
CO5	S	S	M	S	M	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: V **Paper type:** Internal Elective **Paper code:**

Name of the Paper: DATA BASE MANAGEMENT SYSTEM **Credits:** 3

Total Hours per Week: 4 **Lecture Hours:** 3 **Tutorial Hours:** 1 **Practical Hours:** -

……

Course Objectives

1. Impart the significance and structure of DBMS
2. Study essential concepts of entity relationship models
3. Explore relational data based designs
4. Inculcate the deep knowledge in standard query language
5. Acquire to know the concept of PL/SQL

Course Outcomes

The student will be able to

1. Comprehend the knowledge in DBMS
2. Promote the ideas in entity relationship models
3. Create and solve relational data based designs
4. Apply the concepts in standard query language
5. Enhance the significance of PL/SQL

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	✓
3	✓	✓	✓	✓	✓	✓
4	✓	✓	✓	✓	✓	✓
5	✓	✓	✓	✓	✓	✓

UNIT - I

Introduction - DBMS Basic Concepts - Purpose of Database Systems - Database System/ File System - Overall System architecture - Database Languages - Classifications - Data Models.

UNIT - II

Entity relationship model: Mapping constraints - Primary Keys - Foreign Key - Structural Constraints - ER notations - ER model examples - Enhanced Entity Relationship Model: EER Concepts like Generalization, Specialization, Union, Category, Disjoint, Overlapping etc.EER model examples.

UNIT - III

Relational Data Base Design - ER/EER to Relational Mapping algorithm - Relational Model: Structure - Formal Query Languages - Relational Algebra - Informal Design Guidelines - Functional Dependencies - Normalization upto third Normal Form.

UNIT - IV

SQL - Basics of SQL - DDL - DML - DCL - TCL Commands in detail with examples.

UNIT - V

PL/SQL: Stored Procedure Concepts - Procedure - Functions - Cursors - Triggers.

Text Books:

1. H.F. Korth and A.Silberschatz (1988): Database system Concept, McGraw Hill Publication.
2. Albert Lulushi (1997): Developing ORACLE FORMS Applications, Prentice Hall

Reference Books:

1. Ramez Elmasri and B. Navathe, Fundamentals of Database Systems ,3/e, Addison Wesley.
2. Date C.J. (1981). Introduction to Database Systems, Addison-Wesley/

Course Material: website links, e-Books and e-journals

1. https://onlinecourses.nptel.ac.in/noc22_cs51/preview
2. https://archive.nptel.ac.in/courses/106/105/106105175/
3. https://nptel.ac.in/courses/106104135
4. https://onlinecourses.nptel.ac.in/noc20_cs03/preview

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	S	S	M	M
CO2	M	M	M	M	M	M	S	L	M	M
CO3	M	M	S	S	M	M	S	S	M	M
CO4	S	S	M	L	M	S	M	S	S	S
CO5	S	S	M	S	M	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: VI **Paper type:** Internal Elective **Paper code:**

Name of the Paper: MATHEMATICAL ECONOMICS **Credits:** 3

Total Hours per Week: 3 **Lecture Hours:** 3 **Tutorial Hours:** - **Practical Hours:** -

……

Course Objectives

1. Understand the fundamental concept of basics of Mathematical Economics.
2. Bridge the relationship between supply and demand.
3. Construct market structure.
4. Explore the ideas of the execute cost analysis.
5. Get acknowledge on production function and its properties

Course Outcomes

The student will be able to

1. Have an idea about the concept of Mathematical Economics and scope.
2. Compute supply and relation between demand and supply.
3. Calculate the cost analysis.
4. Construct the market structure.
5. Know the concept of theoretical production functions.

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓		✓	
2	✓	✓	✓			✓
3	✓	✓	✓	✓		
4	✓	✓	✓	✓		
5	✓	✓	✓	✓	✓	✓

UNIT - I

Scope and methods of Mathematical Economics - Laws of demand , Demand schedule (Individual and Market) - Demand function - Factors influencing the demand - Exception to the law of demand - Elasticity of demand with respect to price and income - Factors affecting the elasticity of demand - Partial elasticity of demand with respect to price - Simple problems in elasticity of demand.

UNIT - II

Supply - Factors affecting the supply of a commodity - Relation between demand and supply - Utility - Concept of utility - Concept of human wants - Maximization of utility - Marginal and total utility - Law of diminishing marginal utility - Indifference curves and map - Properties of indifference curve - Price line.

UNIT - III

Cost Analysis - Different types of cost - Total, average and marginal cost functions - Relation between average and marginal costs - Problems related to total, average and marginal costs - Revenue - Total, average and marginal revenue functions and their relationship - Simple problems related to maximization of total revenue

UNIT - IV

Market Structure - Definition of Market - Perfect completion - Pure competition -

Monopolistic competition and duopolistic competition (Only concept) - Profit maximisation - Profit function - Carnot solution to monopoly problem for maximization problem - Joint monopoly and discriminating monopoly - Problems related to profit maximization under monopoly. Duopoly - Conjectural variation and reaction curves - Simple maximization problem under duopoly.

UNIT – V

Theoretical Production functions - Mathematical definition of production function - Constant product curves (Isoquant) - Average and marginal productivity - Homogenous production functions - Properties of linearly homogeneous production function – Cobb-Douglas production function - C. E. S. production function

Text Books:

1. Varma and Agarwal (1998): **Managerial Economics,** Sultan Chand and Company, New Delhi.
2. Mehta and Madhnani (2001): **Mathematics for Economists**, Sultan Chand and Company, New Delhi (Chapters 6, 8, and 9).

Reference Books:

1. Allen R.J.D.(1979): Mathematical Economics, Macmillan Press.
2. Madnani, G.M.K. (2008) Introduction to Econometrics: Principles and Applications. Oxford and IBH, New Delhi.
3. Wooldridge, J. (2012). Introduction to Econometrics: A Modern Approach, Cengage Learning, New Delhi.
4. Gujarati, D. N., Dawn C Porter and Sangeethakunasekar (2016). Basic Econometrics, Fifth edition, McGraw Hill, New York

Course Material: website links, e-Books and e-journals

1. http://people.tamu.edu/~gtian/Lecture%20Notes%20for%20ECON660%20and%20ECON460-2019-10
2. https://www.acqnotes.com/Attachments/Price%20Theory%20-%20Supply%20and%20Demand%20Lecture.pdf
3. https://www.vssut.ac.in/lecture_notes/lecture1424714805.pdf
4. https://corporatefinanceinstitute.com/resources/knowledge/economics/market-structure/
5. https://www.britannica.com/topic/theory-of-production

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	L
CO2	S	S	M	M	S	M	S	L	M	M
CO3	M	M	S	S	S	M	S	S	M	M
CO4	S	S	M	L	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: VI **Paper type:** Internal Elective **Paper code:**

Name of the Paper: REAL ANALYSIS **Credits:** 3

Total Hours per Week: 3 **Lecture Hours:** 3 **Tutorial Hours:** - **Practical Hours:** -

……

Course Objectives

1. Understand the concept of set theory and applications
2. Study the terms of real numbers and sequences
3. Impart the significance of the series of real number and its convergence and divergence.
4. Develop the functions and extreme value theorem and it usage
5. Get acknowledge on mean value theorems and its applications

Course Outcomes

The student will be able to

1. Have an idea about the concept of sets and functions
2. Compute the sequence of real numbers.
3. Obtain the series of real numbers.
4. Construct the limit of real valued functions in one variable and uniformly continuous functions.
5. Know the concept of differentiability of functions.

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓			
2	✓	✓	✓		✓	✓
3	✓	✓	✓	✓	✓	
4	✓	✓	✓	✓	✓	
5	✓	✓	✓	✓		✓

UNIT - I

Sets: Sets - elements - Operations on set - Functions: Real valued functions equivalence - Countability - Real numbers - Upper and Lower bounds - Supremum and Infemum.

UNIT - II

Sequence of real numbers: Limit of a sequence - Convergent sequences, Divergent sequences - Bounded sequences - Monotone sequences Cauchy's first and second theorem on limits Cauchy's general principle of convergence

UNIT - III

Series of real numbers: Convergence and divergence - series with non-negative terms - comparison test D'Alembert's ratio test, Cauchy's Root test - Alternating. Series - Conditional convergence and absolute convergence Leibnitz test.

UNIT - IV

Functions: Limit of real valued functions in one variable, continuity types of discontinuities algebra of continuous functions - Extreme value theorem. Intermediate value theorem - Uniformly Continuous functions

UNIT - V

Differentiability of Functions - Rolle's theorem - Mean value theorem for derivatives. Taylor's Series expansion - Application to maxima and minima.

Text Books:

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

Reference Books:

1. Apostol, T.M.(1985): Mathematical Analysis, Narosa Publishing House.
2. Ajit Kumar and Kumaresan, S. (2014). A Basic Course in Real Analysis, Chapman and Hall/CRC Press.
3. Malik, S.C., and Arora, S. (2009). Mathematical Analysis, Second Edition, New Age International, New Delhi.

Course Material: website links, e-Books and e-journals

1. https://byjus.com/jee/sets-relations-and-functions/#:~:text=In%20simple%20words%2C%20a%20function,P%20and%20y%20%E2%88%88%20Q.
2. https://math.mit.edu/~apm/ch03.pdf
3. https://math.libretexts.org/Bookshelves/Calculus/Book%3A_Active_Calculus_(Boelkins_et_al)/08%3A_Sequences_and_Series/8.03%3A_Series_of_Real_Numbers
4. https://en.wikipedia.org/wiki/Limit_of_a_function#:~:text=If%20a%20function%20f%20is,equal%20to%20f(p).
5. https://en.wikipedia.org/wiki/Differentiable_function#:~:text=In%20mathematics%2C%20a%20differentiable%20function,interior%20point%20in%20its%20domain

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	L
CO2	S	S	M	M	S	M	S	L	M	M
CO3	M	M	S	S	S	M	S	S	M	M
CO4	S	S	M	L	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: VI **Paper type:** Internal Elective **Paper code:**

Name of the Paper: STATISTICAL GENETICS **Credits:** 4

Total Hours per Week: 3 **Lecture Hours:** 3 **Tutorial Hours:** - **Practical Hours:** -

……

Course Objectives

1. Understand the concept of basics genetics
2. Study the concept of estimation of parameters using probit models.
3. Compute the estimation of parameters using logit models
4. Explore the various computational method indices
5. Get knowledge on applications of exponential and weibull distribution

Course Outcomes

The student will be able to

1. Have an idea about the concept of statistics genetics
2. Estimate the parameters using probit models
3. Estimate the parameters using logit models
4. Know the concept of biodiversity
5. Develop applications of exponential and weibull distribution

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓		✓	
2	✓	✓	✓			✓
3	✓	✓	✓	✓		
4	✓	✓	✓	✓		
5	✓	✓	✓	✓	✓	✓

UNIT - I

Statistics Genetics: Cells, Chromosomes, Gametes, Genes and Gene frequency, Mendel's law - Single locus with two alleles - Hardy-Weinberg equilibrium - A-B-O blood group system, Calculation of Probabilities of offspring blood group for given parental blood group - Chance of incompatibility.

UNIT - II

Definition of ED50, ED90 etc. - Simple method of estimation of the above. Data: Dose levels (Z,I), number of individuals exposed (n,l), number responding (r,l). Simple regression of probit on log dose to estimate parameters of tolerance distribution.

UNIT - III

Introduction to logistic regression with binary response and one independent variables (continuous) - Exponential and logistic model of population growth, solving the following differential equations: DNt/dt=kNt, dNt(k-Nt). Fitting the above growth models to data by linearization and regression.

UNIT - IV

Capture - recapture method of abundance estimation. One and two recapture occasions. Use of likelihood under binomial distribution - Concept of biodiversity. Simpson's and Shannon-Wiener indices.

UNIT - V

Study of exponential and Weibull distributions as models for survivorship data. Corresponding hazard functions and interpretation of their shapes. Applications to environmental data.

Text Books:

1. D.J.Finney(1978): Statistical Methods in Biological Assays, Charles Griffics & Co.
2. A.P.Gore and S.A. Paranjpe(2000): A course in Mathematical & Statistical Ecology, Kluwer.

References Books:

1. R.C. Elandt Johnson (1975): Probability Models and Statistical Methods in Genetics Wiley.
2. C. C. Li (1976): First course in Population Genetics, Boxwood Press.

Course Material: website links, e-Books and e-journals

1. https://en.wikipedia.org/wiki/Statistical_genetics#:~:text=Statistical%20genetics%20is%20a%20scientific,_the%20context%20of%20human%20genetics.
2. https://fan.princeton.edu/fan/classes/524/notes2.pdf
3. https://www.analyticsvidhya.com/blog/2021/07/an-introduction-to-logistic-regression/#:~:text=Logistic%20Regression%20is%20a%20%E2%80%9CSupervised,used%20for%20Binary%20classification%20problems.
4. https://online.stat.psu.edu/stat504/lesson/1/1.5#:~:text=In%20the%20binomial%2C%20the%20parameter,of%20the%20parameter(s).
5. https://en.wikipedia.org/wiki/Environmental_data

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	L
CO2	S	S	M	M	S	M	S	L	M	M
CO3	M	M	S	S	S	M	S	S	M	M
CO4	S	S	M	L	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: VI **Paper type:** Internal Elective **Paper code:**

Name of the Paper: ACTUARIAL STATISTICS **Credits:** 3

Total Hours per Week: 3 **Lecture Hours:** 3 **Tutorial Hours:** - **Practical Hours:** -

……

Course Objectives

1. Understand the concept of computation of interest and its variants
2. Get idea on the concept of annuities
3. Explore the various related features of annuities
4. Get knowledge of stochastic interest rates
5. Enhance the ideas of the computation of mortality

Course Outcomes

The student will be able to

1. Compute the Effective rate of discount d
2. Have an idea about the increasing and decreasing annuities
3. Calculate the purchase prices of an annuity net of tax
4. Computation of stochastic interest rates
5. Computation of mortality

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓		✓	
2	✓	✓	✓			✓
3	✓	✓	✓	✓		
4	✓	✓	✓	✓		
5	✓	✓	✓	✓	✓	✓

UNIT - I

Effective Rate of Interest i - Nominal Rate of Interest $i^{(m)}$- Force of Interest a - Relationships between different rates of interest - Expression for a by use of calculus -Present values - Effective rate of discount d - Nominal rate of discount $d^{(m)}$.

UNIT - II

Annuities - Immediate Annuity - Annuity - due - perpetuity - accumulation and Present values of Annuities - Increasing and Decreasing annuities - Annuities and interest rates with different frequencies - Continuous Annuities.

UNIT - III

Analysis of Annuity payments - Capital and Interest elements included in the Annuity payments - loan outstanding after t payments - purchase price of Annuities - Annuities involving income tax - Purchase prices of an annuity net of tax.

UNIT - IV

Stochastic interest rates - Independent annual interest annual interest rates - The definition of S_n - Mean and variance of S_n - Definition of A_n - Mean and variance of A_n - Simple problems.

UNIT - V

Probabilities of living and dying - The force of mortality i_x - Estimation of i_x - Uniform Distribution of deaths - Select and Ultimate rates.

Text Books:

1. Donald, D.W.A.(1975).Compound Interest and Annuities certain. Heinemann, London.
2. Frank Ayres,J.R.(1983).Theory and problems of mathematics of Finance. Schaum's outline series, McGraw hill book company, Singapore.

Reference Books:

1. Mc Cutcheon J.J.and Scott.(1989).Mathematics of Finance, Heinemann, London.
2. Neill,A(1977).Life Contingencies, Heinemann, London.
3. Barcley, G. W. (1970). Techniques of Population analysis, Wiley, New York.
4. Donald, D.W.A (1970). Compoung Interest and Annuities-certain, For the Institute of Actuaries and the faculty of Actuaries at the University Press.
5. Spurgeon, E. T. (2011). Life Contingencies, Cambridge University Press, Cambridge.

Course Material: website links, e-Books and e-journals

1. https://www.investopedia.com/terms/e/effectiveinterest.asp#:~:text=Effective%20annual%20interest%20rate%20%3D%20(1,%2F%202))%20%5E%202%20%2D%201
2. https://smartasset.com/retirement/present-value-of-annuity
3. https://en.wikipedia.org/wiki/Annuity
4. https://www.stats.ox.ac.uk/~winkel/bs4a11_l15-16.pdf
5. https://www.investopedia.com/terms/y/yearly-probability-of-dying.asp#:~:text=According%20to%20Smithsonian%20Magazine%2C%20your,another%20year%20are%2050%2F50

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	S	M	L
CO2	S	S	M	M	S	M	S	L	M	M
CO3	M	M	S	S	S	M	S	S	M	M
CO4	S	S	M	L	S	S	M	S	S	S
CO5	S	S	M	S	S	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: III **Paper type:** Skill based Subject **Paper code:**

Name of the Paper: ELEMENTARY MATHEMATICS **Credits:** 2

Total Hours per Week: 3 **Lecture Hours:** 3 **Tutorial Hours:** - **Practical Hours:** -

……

Course Objectives

1. Understand the fundamental principles in differential and integral calculus
2. Study polar coordinates and related concepts
3. Comprehend the ideas of Asymptotes with special cases
4. Create and apply the properties of Reduction formula techniques
5. Describe and apply double integrals

Course Outcomes

The student will be able to

1. Describe the principles of differential and integral calculus
2. Derive the problems related to polar coordinates
3. Develop Asymptotes with special cases
4. Find the results for Reduction formula techniques
5. Apply double integral concepts

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓	
3	✓	✓	✓	✓		✓
4	✓	✓	✓	✓	✓	
5	✓	✓	✓	✓		✓

UNIT - I

Jacobians - Total differential - maxima and minima functions of 2 and 3 independent variable, Lagrange's method (without proof), problems on these concepts.

UNIT - II

Polar coordinates - Angle between radius vector and tangent - Angle between two curves, Curvature, Radius of Curvature in Cartesian and Polar coordinates, p-r equation, Evolutes.

UNIT - III

Asymptotes: Methods (without proof) of finding asymptotes of rational algebraic curves with special cases.

UNIT - IV

Reduction formulae, Beta and Gamma Functions - Properties and Problems.

UNIT - V

Double Integrals - Change of order of Integration - Triple Integrals - Applications to Area, Surface Area and Volume.

Text Books:

1. S.Narayanan and T.K.Manicavachagom Pillay (2004) *Calculus.* S.Viswanathan Printers & Publishers Pvt. Ltd. Chennai.

Reference Books:

1. P.Kandasamy, K.Thilagavathy (2004), Mathematic for B.Sc. Vol.-I, II, III & IV, S.Chand & Company Ltd., New Delhi-55.
2. Shanti Narayan (2001) *Differential Calculus*. Shyamlal Charitable Trust, New Delhi.
3. Shanti Narayan (2001) *Integral Calculus.* S.Chand & Co. New Delhi.
4. S.Sudha (1998) *Calculus.* Emerald Publishers, Chennai.
5. G.B.Thomas and R.L.Finney. (1998) *Calculus and Analytic Geometry*, Addison Wesley (9th Edn.), Mass. (Indian Print)
6. P.R.Vittal. (2004) *Calculus*, Margham Publication, Chennai

Course Material: website links, e-Books and e-journals

1. https://nptel.ac.in/courses/111106146
2. https://onlinecourses.nptel.ac.in/noc21_ma16/preview
3. https://archive.nptel.ac.in/courses/111/104/111104144/

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	M	M	M	L
CO2	S	S	S	S	S	S	S	M	M	L
CO3	S	S	S	S	S	M	M	M	L	M
CO4	S	S	S	S	S	S	S	L	L	M
CO5	S	S	S	S	S	M	M	M	M	M

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: V **Paper type:** Skill based Subject **Paper code:**

Name of the Paper: INDIAN OFFICIAL STATISTICS **Credits:** 2

Total Hours per Week: 2 **Lecture Hours:** 2 **Tutorial Hours:** - **Practical Hours:** -

……

Course 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

The student will be able to

1. Enhance the functions statistical organization in India
2. Develop the features of official statistics
3. Design the techniques of agricultural and industrial statistics
4. Interpret the results of index numbers
5. Gain knowledge on national income and its measures

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓		✓
2	✓	✓	✓	✓		
3	✓	✓	✓	✓		✓
4	✓	✓	✓	✓	✓	
5	✓	✓	✓	✓	✓	✓

UNIT - I

Statistical System in India: Central and State Government Organizations, Functions of Central Statistical Organization (CSO), National Sample Survey Organization (NSSO) - Sampling fundamentals - sampling and non-sampling errors - large scale sample surveys.

UNIT - II

Official statistics: Meaning, methods of collection, limitations and reliability. Principal publications containing data on the topics such as population, agriculture, industry, trade, prices, labour and employment, transport and communications - Banking and finance.

UNIT - III

System of Collection of Agricultural Statistics - Crop forecasting and estimation - Productivity, fragmentation of holdings - Support prices - Buffer stocks - Impact of irrigation projects - Industrial statistics.

UNIT - IV

Index Numbers - Price, Quantity and Value indices. Price Index Numbers: Construction, Uses, Limitations, Tests for index numbers - Consumer Price Index, Wholesale Price Index and Index of Industrial Production - Construction of index numbers and uses.

UNIT - V

National Income - Measures of national income - Income, expenditure and production approaches - Applications in various sectors in India - Wage Statistics - Trade Statistics - Financial Statistics

Text Books:

1. Saluja, M.R (1972): Indian official statistical systems: Statistical publishing society, Calcutta and The Indian Econometric Society, Hyderabad.
2. Central Statistical Organisation (1995), Statistical System in India, Ministry of Statistics and Programme Implementation, India
3. Central Statistical Organisation (1999), Guide to Official Statistics, Ministry of Statistics and Programme Implementation, India.

Reference Books:

1. Goon A. M., Gupta M. K., and Dasgupta. B. (2001), Fundamentals of Statistics, Vol.2, World Press, India.
2. Allen R. G. D. (1975). Index Numbers in Theory and Practice, Macmillan.
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.

Course Material: website links, e-Books and e-journals

1. https://agriculture.uk.gov.in/pages/show/221-agriculture=statistics-Data
2. https://byjus.com/free-ias-prep/nsso
3. https://learneclearn.com/course-detail/629525578cf30573e37bf2c1

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	M	M	M	S	S	M	M
CO2	M	M	M	M	M	M	S	L	M	M
CO3	M	M	S	S	M	M	S	S	M	M
CO4	S	S	M	L	M	S	M	S	S	S
CO5	S	S	M	S	M	S	S	L	S	S

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: III **Paper type:** Non-Major Elective **Paper code:**

Name of the Paper: STATISTICAL METHODS – I **Credits:** 2

Total Hours per Week: 3 **Lecture Hours:** 3 **Tutorial Hours:** - **Practical Hours:** -

……

Course Objectives

1. Get knowledge in statistics and their limitations
2. Expand their ideas in measures of central tendency and dispersion
3. Comprehend the statistical sampling techniques
4. Acquire proficiency in correlation and regression
5. Nurture advancement in statistical theory and applications

Course Outcomes

The student will be able to

1. Comprehend the theoretical aspects of Statistics
2. Recognize the applications of measures of central tendency and dispersion
3. Develop the statistical sampling techniques
4. Compute Correlation and Regression methods
5. Utilize statistical techniques effectively for data analysis

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	
2	✓	✓	✓	✓	✓	✓
3	✓	✓	✓	✓	✓	✓
4	✓	✓	✓	✓	✓	✓
5	✓	✓	✓	✓	✓	

UNIT - I

Statistics - Definitions - limitation of statistics - collection of data - primary data - secondary data - Diagrammatic and Graphical representation of data.

UNIT - II

Descriptive Measures - Mean, Median, mode, standard deviation, skewness and kurtosis (ungrouped data only).

UNIT - III

Concept of sample and Population - Preparation of questionnaire and Pre-testing - Simple random, Stratified random and Systematic sampling techniques.

UNIT - IV

Study of relationship between variables: Concept of correlation - Karl Pearson and Spearman rank correlation - simple problems. Qualitative: Contingency tables - Measures of Association. Concept of simple regression - simple problems.

UNIT - V

Elements of Compound interest (nominal and effective rates of interest, annuities certain, present values, accumulated amounts, deferred annuities) - the functions included in compound interest - tables and their uses.

Text Books:

1. Gupta,S.P. (2014): Statistical Methods, Sultan Chand& Sons Pvt Ltd. New Delhi.
2. Federation of Insurance Institutes Study Courses - Mathematical Basis of Life Assurances F1,2.

Reference Books:

1. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of Applied Statistics, Sultan Chand 1.
2. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics, Vol I and II, World Press, Kolkata. & Sons.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2011). Introduction to the Theory of Statistics, 3rd Edn., Tata McGraw-Hill Pub. Co. Ltd.
4. Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
5. Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. New Delhi.

Course Material: website links, e-Books and e-journals

1. https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2. https://onlinecourses.nptel.ac.in/noc19_ma32/preview
3. https://onlinecourses.nptel.ac.in/noc20_mg23/preview

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	M	M
CO2	S	S	S	S	S	S	M	M	M	L
CO3	S	S	S	S	S	S	M	L	M	M
CO4	S	S	S	S	S	M	M	M	L	M
CO5	S	S	S	S	S	S	M	L	L	L

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low

Semester: IV **Paper type:** Non-Major Elective **Paper code:**

Name of the Paper: STATISTICAL METHODS – II **Credits:** 2

Total Hours per Week: 2 **Lecture Hours:** 2 **Tutorial Hours:** - **Practical Hours:** -

……

Course Objectives

1. Understand growth rates of population and projection
2. Study Mortality rates and life tables
3. Comprehend the ideas of point and interval estimation
4. Impart knowledge on Parametric tests
5. Impart knowledge on Non-Parametric tests

Course Outcomes

The student will be able to

1. Compute growth rates population
2. Construct Mortality rates and life table
3. Compute point and interval estimate population parameters
4. Perform Parametric tests and draw inferences
5. Perform Non-Parametric tests and draw inferences

Matching Table (put ✓ in the appropriate box)

Unit	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
1	✓	✓	✓	✓	✓	
2	✓	✓	✓	✓	✓	✓
3	✓	✓	✓	✓		
4	✓	✓	✓	✓	✓	✓
5	✓	✓	✓	✓		

UNIT - I

Population growth and change - arithmetic, geometric and exponential growth rates - Population estimation and projection.

UNIT - II

Measures of mortality - Crude and Specific rates- Infant mortality rate - direct and indirect standardization of death rates - Complete life table.

UNIT - III

Estimation - Point estimation - interval estimation - mean - variance - proportions - simple problems.

UNIT - IV

Parametric Tests - Testing of significance of small and large sample tests - t-test, chi-square test - F test - z-test.

UNIT - V

Non- Parametric tests - Sign test, Wilcoxon test, Mann-Whitney U Test. Median test, Run test, Kolmogorov - Smirnov One Sample test. Chi- Square Tests - Goodness of fit - Test of independence of attributes.

Text Books:

1. Gupta,S.P (2014): Statistical Methods, Sultan Chand & Sons .
2. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of Applied Statistics, Sultan Chand & Sons.

Reference Books:

1. Rohatgi, V.K. (1984) An introduction to probability theory and Mathematical Statistics, Wiley Eastern.
2. Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-Calculus Based Approach. Narosa Publishing Comp. New Delhi.
3. Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
4. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2011). Fundamental of Statistics, Vol I and II, World Press, Kolkata.

Course Material: website links, e-Books and e-journals

1. https://www.coursera.org/learn/statistical-inference-for-estimation-in-data-science
2. https://ocw.tudelft.nl/courses/digital-signal-processing/subjects/4-estimation-theory/

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	S	S	S	S	S	M	S	M	M	L
CO3	S	S	S	S	S	S	M	L	M	L
CO4	S	S	S	S	S	M	S	M	M	M
CO5	S	S	S	S	S	M	M	M	M	M

PO – Programme Outcome; CO – Course outcome; S – Strong, M – Medium, L – Low