

**UNIVERSITY OF MADRAS**

**BACHELOR OF STATISTICS DEGREE COURSE IN STATISTICS**

**CHOICE BASED CREDIT SYSTEM (CBCS) WITH GRADING SEMESTER SYSTEM WITH CREDITS**

**Curriculum Framework and Syllabus for Outcome Based Education in**

**Dwaraka Doss Goverdhan Doss Vaishnav College (Autonomous)**

**B.Sc., (Statistics)**

**(Effective from the Academic year 2023-24)**

**REGULATIONS**

**1. ELIGIBILITY FOR ADMISSION**

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

**2. ELIGIBILITY FOR AWARD OF DEGREE**

A Candidate shall be eligible for the award of the B.Sc., (Statistics) Degree only if he/she has undergone the prescribed course of study in a college affiliated to the University for a period of not less than three academic years, passed the examinations of all the six semesters prescribed, earning 140 credits and also fulfilled such conditions as may have been prescribed thereof.

**3. DURATION OF THE COURSE**

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

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

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

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

#### 4. COURSE OF STUDY, CREDITS AND SCHEME OF EXAMINATION

(a) The main subject of study for B.Sc., (Statistics) shall consist of the following:

##### FOUNDATION COURSES

- PART – I** : Language (I to IV Semesters) Tamil or Other Language  
**PART – II** : English (I to IV Semesters)

##### CORE COURSES

**PART – III** : (a) Core subjects (b) Allied Subjects, (c) Project/ Elective subjects related to the main subject of study

**PART – IV** : (a) Non- Major Elective / Basic Tamil / Advanced Tamil (I & II Semesters)

- a. Environmental Studies (IV Semester)
- b. Soft Skill (I, II, III and IV Semester)
- c. Value Education (V Semester)

**PART – V** : **Compulsory Extension Service**

- (a) A candidate shall be awarded one credit for compulsory extension service.
- (b) Total Number of Credits shall be 140 credits.
- (c) Details of Course of Study (Part I to V)

**PART – I** : **Tamil or Other Language**

Tamil or any one of the following Modern (Indian or Foreign) or Classical languages at the option of candidates and according to the syllabus and text books prescribed from time to time.

**PART – II** : **English**

According to the syllabus and text books prescribed from time to time.

**PART – III** : **Core, Allied, Elective subjects, Project work**

As prescribed by the concerned Board of Studies from time to time.

**Part – IV: Non- Major Elective / Basic or Advanced Tamil**

- (a) Students who have not studied Tamil up to XII STD and have taken any Language other than Tamil in Part I shall take Basic Tamil comprising of two courses (Level will be at 6<sup>th</sup> Standard). (I & II Semesters)

(b) Students who have studied Tamil up to XII STD and have taken any Language other than Tamil in Part I shall take Advanced Tamil comprising of Two Courses.

(c) Students who have studied Tamil up to XII STD and also have taken Tamil in Part I shall take Non-Major Elective comprising of Two Courses. (I & II Semesters)

**Soft skill courses / Environmental studies / Value Education:**

According to the syllabus prescribed from time to time.

**Part – V : Compulsory Extension Activity**

All the students shall enroll for NSS / NCC / NSO (Sports & Games) / Rotract / Youth Red Cross or any other service organization in the college and shall have to put in compulsory minimum attendance of 40 hours which shall be duly certified by the Principal of the college before 31<sup>st</sup> March in a year. If a student LACK of 40 HOURS ATTENDANCE in the first year, he /she shall have to compensate the same during the subsequent years. Literacy and population, educational field work shall be compulsory components in the above extension service activities.

## VISION

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

## MISSION

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

## PROGRAM EDUCATION OBJECTIVES (PEOs)

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

## PEO TO MISSION STATEMENT MAPPING

MISSION STATEMENTS	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5
<b>M1</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>2</b>
<b>M2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>
<b>M3</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>

**CORRELATION:    3- STRONG                    2- MEDIUM                    1- LOW**

## PROGRAMME OUTCOMES [PO] FOR UNDER GRADUATE

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

<b>PO1</b>	To participate in various types of employment, development activities and public discourses particularly in response to the needs of the community one serve.
<b>PO2</b>	To implement discipline, professionalism, team spirit, communication skills, social and ethical commitment in the under graduates in order to embellish leadership roles expediting perfection in different sector with a categorical professional distinctiveness, business savvy, international recognition and imperishable expansion.
<b>PO3</b>	To improve the problem-solving skill to identify possible solutions and choosing the correct solution for any problem.
<b>PO4</b>	To enhance the competencies to support national, regional and local development plans and to create questioning mind.
<b>PO5</b>	To enhance the critical thinking ability to think clearly and rationally while understanding the logical connection between ideas in a reflective and independent thinking and Lifelong learning and enduring proficient progress.

### MAPPING OF PO TO PEO

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

**CORRELATION: 3- STRONG 2- MEDIUM 1- LOW**

## PROGRAMME SPECIFIC OUTCOMES [PSO] FOR B.SC STATISTICS

### Program Specific Outcomes

PSO1	To Collect and handle the data.
PSO2	To carry out Statistics and Mathematical computation, both analytical and numerical to a reasonably good level.
PSO3	Identify the Suitable approaches and Statistical techniques using for a given data.
PSO4	Ability to solve the problem and Interpret the Solution.
PSO5	Facilitate numerical approximation to everyday life problems.

## 5. Course Curriculum:

Dwaraka Doss Goverdhan Doss Vaishnav College (Autonomous), Chennai – 600 106.

[Affiliated to University of Madras]

**B.Sc., Statistics Curriculum**

**(Batch 2023 - 2024 Onwards)**

Semester - I	Credits	Hours	Semester - II	Credits	Hours
1.Language–I	3	4	1.Language–II	3	4
2. English - I	3	4	2. English - II	3	4
3.Descriptive Statistics	4	6	3.Probability and Random Variables	4	4
4. Core Practical – I		6	4. Computational Statistics With Excel	3	4
5. Mathematics for Statistics	5	6	5. Core Practical – I	4	3
6.Non Major Elective -I	2	2	6. Core Practical – II ( Based on Excel)	2	2
7.Soft Skills –I	3	2	7. Real Analysis	5	5
			8.Non Major Elective -II	2	2
			9.Soft Skills –II	3	2
<b>Total</b>	<b>20</b>	<b>30</b>		<b>29</b>	<b>30</b>
Semester - III	Credits	Hours	Semester - IV	Credits	Hours
1.Language–III	3	6	1.Language–IV	3	6
2. English - III	3	4	2. English - IV	3	4
3.Distribution Theory	4	5	3.Statistical Inference - I	4	5
4. Core Practical – III		4	4. Core Practical – III	4	4
5. C Programming Language (Theory)	3	5	5. Numerical Methods	4	5
6. Allied Practical –I Programming in C	2	2	6. Numerical Methods with C Programming( Practical)	2	2
7.Soft Skills –III	3	2	7.Soft Skills –IV	3	2
8. Environmental Studies		2	8. Environmental Studies Internship ( 2 Weeks )	-	
<b>Total</b>	<b>18</b>	<b>30</b>	<b>Total</b>	<b>25</b>	<b>30</b>
Semester - V	Credits	Hours	Semester - VI	Credits	Hours
1.Operations Research	4	5	1.Design of Experiments	4	5
2.Statistical Inference – II	4	5	2. Actuarial Statistics	4	5
3.Sampling Theory	4	5	3. Time Series, Index Numbers and Official Statistics	4	5
4.Statistical Quality Control	4	5	4. Core Practical IV	4	4
5. Demography (or) Statistical Applications with R-Language.	5	5	5. Stochastic Processes (or) Differential Equations , Fourier Series and Fourier Transformation	4	5
6.Core Practical – IV		4	6. Mathematical Economics (or) International Trade	4	5
7. Value Education	2	1	7. Extension Activity	1	1
<b>Total</b>	<b>23</b>	<b>30</b>	<b>Total</b>	<b>25</b>	<b>30</b>

**APPENDIX – 19(ii) (R&S)**  
**UNIVERSITY OF MADRAS**  
**B.Sc. DEGREE COURSE IN STATISTICS**

**Outcome Based Education**  
(w.e.f.2023-2024)

**DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE (AUTONOMOUS)**

**Shift - II**  
**REGULATIONS**  
(As per Common Regulations framed by University of Madras)

**SCHEME OF EXAMINATIONS**

**B.Sc. Statistics - I SEMESTER**

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
<b>Part –I</b> - Language Paper –I	3	50	50	100
<b>Part –II</b> - English Paper –I	3	50	50	100
<b>Part-III</b> Core Paper-I: Descriptive Statistics	4	50	50	100
Core paper – IV – Core Practical – I	Practical examination will be at the end of the semester II.			
Allied Paper- I – Mathematics for Statistics	5	50	50	100
<b>Part-IV:</b> * Basic Tamil/Adv. Tamil Non Major Elective –I	2	50	50	100
Soft Skills –I	3	50	50	100
<b>Total</b>	<b>20</b>	<b>300</b>	<b>300</b>	<b>600</b>

**B.Sc. Statistics - II SEMESTER**

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
<b>Part –I</b> – Language Paper –II	3	50	50	100
<b>Part –II</b> - English Paper –II	3	50	50	100
<b>Part-III</b> Core Paper -II: Probability and Random Variables	4	50	50	100
Core Paper-III: Computational Statistics with Excel	3	50	50	100
Core Paper – IV: Core Practical –I	4	50	50	100
Core Paper – V : Core Practical – II (Based on Excel)	2	50	50	100

Allied paper- II – Real Analysis	5	50	50	100
<b>Part-IV</b> * Basic Tamil/Adv. Tamil/ Non Major Elective –II	2	50	50	100
Soft Skills – II	3	50	50	100
Total	29	450	450	900

**B.Sc. Statistics - III SEMESTER**

Course Components/Title of the paper	Credits	MARKS		
		CI A	EXT	TOTAL
<b>Part –I</b> – Language Paper –III	3	50	50	100
<b>Part –II</b> – English Paper –III	3	50	50	100
<b>Part-III</b> Core paper-VI: Distribution Theory	4	50	50	100
Core IX – Core Practical III	Practical examination will be at the end of semester IV			
Allied paper- III- C Programming Language	3	50	50	100
Allied Practical – I Programming in C (Lab)	2	50	50	100
Soft Skills –III	3	50	50	100
Total	18	250	350	600

**B.Sc. Statistics - SEMESTER – IV**

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
<b>Part –I</b> - Language Paper –IV	3	50	50	100
<b>Part –II</b> - English Paper –IV	3	50	50	100
<b>Part-III</b> Core Paper-VII: Statistical Inference – I	4	50	50	100
Core Paper VIII : Core Practical III	4	50	50	100
Allied paper- IV – Numerical Methods	4	50	50	100
Allied Practical – II Numerical Methods with C Programming	2	50	50	100
Environmental Studies	2	50	50	100
Soft Skills-IV	3	50	50	100
Total	25	400	400	800



**B.Sc. Statistics - V SEMESTER**

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
<b>Part-III</b> Core Paper-X : Operations Research	4	50	50	100
Core Paper - XI: Statistical Inference – II	4	50	50	100
Core Paper - XII: Sampling Theory	4	50	50	100
Core Paper - XIII – Statistical Quality Control	4	50	50	100
Core Elective Paper -I: Demography (or) Statistical Applications with R- Language.	5	50	50	100
Core XVII – Core Practical – IV	Practical examination will be at the end of the semester VI			
Value Education	2	50	50	100
<b>Total</b>	23	300	300	600

**B.Sc. Statistics - VI SEMESTER**

Course Components/Title of the paper	Credits	MARKS		
		CIA	EXT	TOTAL
<b>Part-III</b> Core Paper-XIV: Design of Experiments	4	50	50	100
Core Paper -XV: Actuarial Statistics	4	50	50	100
Core Paper XVI –Time Series, Index Numbers and Official Statistics	4	50	50	100
Core Paper XVII– Core Practical IV	4	50	50	100
Core Elective Paper II : Stochastic Processes (or) Differential Equations , Fourier Series and Fourier Transformation	4	50	50	100
Core Elective Paper III: Mathematical Economics (or) International Trade	4	50	50	100
<b>Part-V</b> Extension Activity	1			
<b>Total</b>	25	300	300	600

Code& Title :2364101& Descriptive Statistics  
Course Type : Core

Semester : I  
Credits : 4

**Course objectives:**

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

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

CO1	To know how to collect and classify the data and its limitations
CO2	To analyze and Present/compare the data using Diagrams and Graph
CO3	To know all the descriptive values of Statistics
CO4	How to find correlation analysis for different data and different methods
CO5	To understand when to apply the Regression Analysis

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Nature and scope of statistical methods and their limitations –concepts of research design- primary and secondary sources of data - nominal, ordinal, ratio and interval scale - complete enumeration, observational studies and sample surveys.	10	CO1
2	Presentation by tables and diagrams- Construction of tables with one, two and three factors of classifications - Diagrammatic representations, frequency distributions for continuous and discrete data, graphical representation of a frequency distribution by histogram and frequency polygon, cumulative frequency distributions (inclusive and exclusive methods) and Ogives.	15	CO2
3	Measures of location, dispersion, moments and measures of skewness and kurtosis for both grouped and ungrouped data.	10	CO3
4	Correlation- Scatter diagram, Karlpearson's co-efficient and its properties, Spearman's rank correlation coefficient, principle of least squares and fitting of first, second degree and exponential curves,	10	CO4
5	Regression Equations- properties of regression equations, regression lines and concept of error in regression - partial and multiple correlation- concepts. Association of attributes and simple problems.	15	CO5

#### **Suggested Reading Books for Study:**

- 1) Richard I. Levin, David S. Rubin (2008), Statistics for Management Pearson.
- 2) Goon, AM., Gupta M.K and Dasgupta B (1991): Fundamentals of Statistics, Vol.1, World Press, Calcutta.
- 3) M.R. Spiegel (1961): Theory and problems of statistics, Schaum's outline series
- 4) Bhat B.R, Srivenkataramana T, and Madhava K.S, (1996) Statistics: A Beginner's text Vol. I, New Age International (P) Ltd.

#### **Books for Reference:**

- 1) G.U. Yule and M.G. Kendall (1956): An introduction to the theory of Statistics, Charles Griffin.
- 2) Snedecor .G.W. and Cochran W.G. (1967): Statistical methods, Iowa State University Press.
- 3) Anderson, T.W. and Sclove SL. (1978): An introduction to statistical analysis of data, Houghton Mifflin co.
- 4) Croxton FE, and Cowden D.J. (1973) Applied General Statistics, Printice Hall of India.

Course Code& Title :2364205 & Probability and Random variables Semester : II  
 Course Type : Core Credits: 4

**Course objectives:**

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

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

CO1	To know the principles of Probability
CO2	To solve the problems based on discrete and continuous random variables
CO3	To know the concept of MGF, CGF, Skewness and Kurtosis and solving problems
CO4	To understand the concept of CLT, convergence in probability.
CO5	To know the concept of Bivariate distributions.

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	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. Addition theorem of probability, conditional probability, independence of events multiplication theorem - Baye's theorem and its applications.	15	CO1
2	Definition of discrete and continuous random variables - probability mass function, distribution functions and probability density functions and their properties. Expectation of random variables and its properties.	10	CO2
3	Moment generating function, characteristic function, cumulate generating function - their properties, moments, measures of locations, dispersion, Skewness and Kurtosis for discrete and continuous variants-simple problems	10	CO3
4	Central Limit Theorem- Lindeberg- Levy, Demovier's (statement only) - convergence in probability, convergence in distribution, convergence in mean	10	CO4

	square- simple problems.		
5	Bivariate distributions - discrete and continuous type, cumulative distribution function(c.d.f.), and probability mass function (p.m.f) and probability density function (p.d.f.)Marginal and Conditional expectation.	15	CO5

**Suggested Reading Books for Study:**

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. (2002): Introduction to Mathematical Statistics, 4thed. Academic Press.
3. A.M.Goon, M.K.Gupta and B. Dasgupta (1980): An outline of Statistical theory, Vol. I,6th revised, World Press.

**Books for Reference:**

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

**Websites:**

<https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library>

<https://ocw.mit.edu/courses/18-440-probability-and-random-variables-spring-2014>

Course Code & Title: 2364206 & Computational statistics with excel Semester: II  
 Course Type: Core Credits: 3

**Course objectives:**

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

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

CO1	To understand the importance of excel application.
CO2	To Study the basic features and features for data analytics of excel.
CO3	To create formulae and use existing functions in excel.
CO4	To acquire knowledge on data entry and manipulate data in excel sheet.
CO5	Can perform data preprocessing and data analytics with the acquired statistical knowledge.

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Introduction: Excel Environment- Introduction-Menus, Tool bars and icons, Spreadsheet application, Create, save and switch between spreadsheets, formatting Spreadsheet-Manipulating Text.	15	CO1
2	Entering and editing data in Spreadsheet-Import data from web-Filtering and sorting data in excel-Creating hyperlinks-Cell referencing –Numeric formats-Array formula in excel-Diagrams and graphs-Set print area-printing	10	CO2
3	Data Preprocessing-Data Cleaning-Data normalization, Integration and transformation--Pivot tables-Heat Maps	10	CO3
4	Functions-Excel functions and Formula-Formulae in excel-logical functions-Test functions-Basic statistical functions-Basic mathematical functions-Basic Financial functions-Data Manager - Descriptive Statistics, Histogram, Correlation, Regression.	10	CO4
5	Dashboards for Excel-Data Visualization-Excel data presentation library- Dashboard design, tools and concepts-Elements of Excel dashboard and decision support system.	15	CO5

**Books for study/ reference:**

1. Bernd Held (2006), *Microsoft Excel Functions and Formulas*, Wordware Publishing, Inc.
2. Jordan Gold Meier and Purnachandra Duggirala (2015), *Dashboards for excel*, Apress.
3. *Microsoft excel 2019-Step by Step*, Curtis Frye, Microsoft press store.
4. Rudy LeCorps (2002), *Microsoft Excel fundamentals, A practical workbook for beginners and Advanced Users*, RGL Publishing.

Course Code & Title : 2364312 & Distribution Theory  
 Course Type: Core

Semester: III  
 Credits: 4

**Course objectives:**

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

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

CO1	To know the problem of discrete distributions – Binomial, Trinomial, Multinomial and Uniform distributions
CO2	To know the problem of discrete distributions – Poisson, Negative Binomial, Geometric and Hyper-geometric Distribution
CO3	To solve the continuous distributions - Normal, Uniform, Exponential
CO4	To understand concept of order statistics with simple problems.
CO5	To know the sampling distributions

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

SI No.	Contents of Module	Hrs	COs
1	Discrete distributions: Bernoulli, Binomial, fitting a Binomial distribution, Trinomial, Multinomial, Uniform distributions with their properties- simple problems.	15	CO1
2	Discrete distributions: Poisson, limiting case of Poisson, fitting of Poisson, Negative Binomial, Geometric and Hyper-geometric Distribution with their properties- simple problems.	10	CO2
3	Continuous distributions: Normal, Uniform, Exponential, Gamma and Beta distributions and their properties.	10	CO3
4	Order statistics-distribution of first, $n^{\text{th}}$ and $i^{\text{th}}$ order statistics, joint distribution of $n^{\text{th}}$ and $i^{\text{th}}$ order statistics-distribution of median and range- Simple problems.	10	CO4
5	Sampling Distributions – Concept - Chi-square, Student's t and F distributions - Derivation of t, F and chi-square distributions with properties – Relation among t, F and chi-square distributions.	15	CO5

**Suggested Reading Books for Study:**

1. Parimal Mukhopadhyay,(1996), Mathematical Statistics, New Central Book Agency
2. Goon, AM., Gupta M.K and .Dasgupta B (1991): Fundamentals of Statistics, Vol.1, World Press, Calcutta

**Books for Reference:**

1. Hogg, R. V and Craig, A. T (2002), Introduction to Mathematical Statistics, Pearson Education Asia, India.
2. A.M.Mood, F.A. Graybill and D.C. Boes (1974): Introduction to the theory of Statistics, International student ed. McGraw Hill.

**Website:**

[www.britannica.com](http://www.britannica.com)



Course Code & Title : 2364417 & Statistical Inference- I  
 Course Type : Core

Semester: IV  
 Credits: 4

**Course objectives:**

1. To know the concepts of Sampling distributions, Point Estimation and Unbiasedness.
2. To analysis the concepts of Testing of Hypothesis and Test of Significance.

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

CO1	To know the Point Estimation and its properties
CO2	To know the MVUE, Cramer- Rao inequality, Rao - Blackwell theorem
CO3	To know the concept of Interval Estimation
CO4	To know the Testing of Hypothesis and solving the problems based on it.
CO5	To know the Testing of Significance and solving the problems based on it.

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

S. No.	Contents of Module	Hrs	COs
1	Point Estimation – Properties of Estimators – Concepts of Unbiasedness, consistency, Efficiency and Sufficiency – Statement of Neyman-Pearson Factorization theorem – Simple Problems.	10	CO1
2	Minimum Variance Unbiased Estimator (MVUE) - Cramer- Rao inequality - simple problems, Rao - Blackwell theorem- Lehman- Scheffe theorem.	15	CO2
3	Interval Estimation - Confidence Interval for proportions, mean(s), variance and variance ratio based on Normal, Student's t, F and chi square distributions.	10	CO3
4	Testing of Hypothesis - Neymann - Pearson theory - Statistical Hypothesis - Simple and composite hypothesis, Null and Alternative Hypothesis - Two types of errors – critical region- power of a test - Most powerful test - Neyman-Pearson lemma.	10	CO4
5	Test of significance- Exact test based on Z, t, F and Chi square with regards mean(s), proportion(s), variance and variance ratio test - simple problems.	15	CO5

**Suggested Reading Books for Study:**

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

**Books For Reference:**

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

Course Code & Title : 2364523 & Operations Research Semester: V  
 Course Type : Core Credits: 4

**Course objectives:**

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

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

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

**Mapping of CO with PO & PSO:**

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

3-Strong 2-Medium 1-Low

Sl No.	Contents of Module	Hrs	COs
1	Introduction to Operations Research - Nature, Scope, Functions, Linear programming problem - Formulation of LPP - Solving the LPP by graphical method. Solving the LPP by simplex method, Big-M method, Duality in LPP, Dual simplex method and problems.	10	CO1
2	Transportation problem- obtaining initial feasible and optimal solutions. Optimality test, degeneracy, Unbalanced transportation problem, Assignment problem, and unbalanced assignment problem - Traveling salesman problem.	10	CO2
3	Replacement Problems- Replacement of items that deteriorate with time- Replacement age of a machine taking money value into consideration- Replacement of items that fail completely- Mortality and staffing attributes.	15	CO3
4	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.	10	CO4

5	Network analysis by CPM / PERT basic concepts - constraints in Network – construction of the network - Time calculations - Concepts of slack and float in Network Analysis -finding optimum project duration and minimum project cost, finding expected project time and variance.	15	CO5
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**Suggested Reading Books for Study:**

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

**Books for Reference:**

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

Course Code & Title : 2364524 & Statistical Inference- II Semester: V  
 Course Type : Core Credits: 4

**Course objectives:**

1. To know the concepts of Methods of estimation and Method of minimum chi-square.
2. To analysis the concepts of uniformly most powerful tests and Non-Parametric tests.

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

CO1	Solving Methods of estimation.
CO2	Analysis the concepts of Method of minimum chi-square and method of least squares
CO3	Analyze the Uniformly most powerful tests, Likelihood ratio criterion - Definition and test for means and variance
CO4	Understand the concept of non-parametric test - run, sign and median test.
CO5	Understand the Mann Whitney tests (one sample and two sample), Kruskal Wallis test - Applications and simple problems.

**Mapping of CO with PO & PSO:**

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

3-Strong 2-Medium 1-Low

Sl No.	Contents of Module	Hrs	COs
1	Methods of estimation: Method of Moments and Method of Maximum Likelihood Estimators with their properties -simple problems.	15	CO1
2	Method of minimum chi-square, Method of Minimum Variance, method of least squares- simple problems.	10	CO2
3	Uniformly most powerful tests –Likelihood ratio criterion - Definition and test for means and variance (one sample only).	10	CO3
4	Non-parametric tests–definition–advantages and disadvantages Run, Sign, Wilcoxon Signed rank test, Median test- simple problems.	10	CO4
5	Non-parametric tests - Kolmogorov's Smirnov one sample test, Mann Whitney tests (one sample and two samples), Kruskal Wallis test - Applications and simple problems.	15	CO5

**Suggested Reading Books for Study:**

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

**Books for Reference:**

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

Course Code & Title : 2364525 & Sampling Theory

Semester: V

Course Type : Core

Credits: 4

**Course objectives:**

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

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

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

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Design - Organization and execution of sample surveys - principle steps in sample survey- Pilot survey - principles of sample survey - sampling and non-sampling errors - advantages of sampling over census - limitations of sampling.	10	CO1
2	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.	15	CO2
3	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.	15	CO3
4	Systematic sampling – methods of systematic sampling: Linear, circular of systematic sampling, properties and limitations of systematic sampling - Estimate of mean and variance of the estimated mean – comparison of simple and stratified with systematic random sampling – $\text{var}(\bar{X}_{st}) \leq \text{var}(\bar{X}_{sys}) \leq \text{var}(\bar{X}_{srswor})$	10	CO4
5	Varying Probability Sampling: PPS selection – cumulative total method – Lahiri’s method – estimation in PPS sampling with replacement total and its sampling variance.	10	CO5

**Suggested Reading Books for Study:**

1. William, G. Cochran (1984): Sampling techniques, Wiley Eastern. Murthy, M.N.(1967): Sampling theory and methods, Statistical Publishing Society, Calcutta.
2. Sampath S. (2005): Sampling theory and methods (2<sup>nd</sup> Edition). Alpha science International Ltd.
3. Murthy M.N. (1967): Sampling Theory and Methods, Statistical Publishing Society, Calcutta.

**Books for Reference:**

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



Course Code & Title : 2364526 & Statistical Quality Control Semester: V  
 Course Type : Core Credits: 4

**Course objectives:**

1. Acquire knowledge of theory of Control charts, attribute and variable control charts.
2. Obtained concepts of acceptance sampling and demonstration plan.

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

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

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Need for Statistical Quality Control techniques in Industry - Causes of Quality variation control charts - Use of the Shewhart - control chart - Specification and tolerance limits – 3sigma limits - warning limits - application of theory of runs in quality control.	15	CO1
2	Control chart for variables - $\bar{X}$ chart, R chart, $\sigma$ chart - purpose of the charts - Basis of subgrouping - plotting $\bar{X}$ and R results - determining the trial control limits - Interpretation of control charts $\bar{X}$ and R. 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.	10	CO2
3	Acceptance of sampling plans for attributes - Producer's risk and consumer's risk - Single, double and multiple sampling plans –associated performance measures.	10	CO3
4	Sequential sampling plan: Definition - Sequential Probability Ratio Test – OC and ASN functions - Five points on OC and ASN curve.	10	CO4
5	Variable sampling plans - Sigma known and sigma unknown determination of n and k for one sided specification - OC curve- concepts and simple problems.	15	CO5

## **Suggested Reading**

### **Books for Study:**

1. Gupta, R.C.(1974): Statistical Quality Control.
2. Montgomery, D.C. (1983): Introduction to Statistical Quality Control, John Waley & Sons.

### **Books for Reference:**

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

Course Code & Title : 2364628 & Design of Experiments  
 Course Type : Core

Semester: V  
 Credits: 4

**Course objectives:**

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

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

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

**Mapping of CO with PO & PSO:**

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

3-Strong 2-Medium 1-Low

Sl No.	Contents of Module	Hrs	COs
1	Fundamental Principles of Experiments - Replication, Randomization and Local Control Techniques - Size of experimental unit-Methods of determination of experimental units -Basic linear model and its assumptions.	15	CO1
2	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.	10	CO2
3	Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) and its analysis.	10	CO3
4	Missing plot technique- Estimating missing observation RBD with one or two missing observations and LSD with one missing observation - Analysis of covariance in CRD with single covariate, difference between ANOVA and ANOCOVA.	15	CO4
5	Factorial experiments and their need, $2^2$ , $2^3$ and $2^k$ factorial experiments and their analysis - Principles of confounding-Partial and Complete confounding in $2^2$ , $2^3$ .	10	CO5

**Suggested Reading Books for Study:**

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

**Books for Reference:**

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

Course Code & Title : 2364629 & Actuarial Statistics  
 Course Type : Core

Semester: VI  
 Credits : 4

**Course objectives:**

1. To acquire the concept of interest, derive the different types of annuities, redemption of loans by uniform yearly payment and concept of mortality.
2. Understanding concept of principles of insurances and concept of netpremium of assurance.
3. To acquire the concept of mortality measurements and measures of fertility in vital statistics.

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

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

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Premiums – Natural premium – Level premium – Net premium – Office premium – Bonus loading with profit and without profit – Policy value – Retrospective policy value and prospective policy value.	15	CO1
2	Elements of compound interest-nominal and Effective rates of interest, Accumulated value and present value of a sum under fixed and varying values of interest. Annuity – Classifications of annuities – Present and accumulated values of annuities – Immediate annuity due and deferred annuity – Simple problems.	10	CO2
3	Principle of insurance – Assurance benefits – Types of assurance – Endowment assurance, pure endowment assurance, whole life insurance and temporary assurance.	15	CO3
4	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, standardrates – direct and indirect – Simple problems.	10	CO4

5	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 – Simple Problems.	10	CO5
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### **Suggested Reading**

#### **Books for Study:**

1. Federation of Insurance Institutes Study Courses – Mathematical Basis of Life Assurances F1, 2
2. Donald. D. W. (1970) – Compound Interest and Annuities, Heinemann, London.
3. Gupta. S. C. and Kapoor. V. K., “Fundamentals of Applied Statistics” (2nd edition – 1978), Sultan Chand & Sons, New Delhi.
4. Bogue, Donald. J: Principles of Demography, (1976), John Wiley, New York.

**Course objectives:**

1. To obtain the knowledge of Time series, measurement of variations, Quantity index numbers and Official Statistics.
2. Understand the concept of factor reversal test and CSO and NSSO.

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

CO1	To know about concepts of Time series and measurement of trend.
CO2	To know the concept of measurement of seasonal variations.
CO3	To know the concept of learn the methods of Index Numbers – problem of constructing index numbers.
CO4	To know the optimum test for index numbers - Time reversal test - factor reversal test - cost of living index numbers.
CO5	To know the concept of Official Statistics - Statistical System in India CSO and NSSO

**Mapping of CO with PO & PSO:**

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

3-Strong 2-Medium 1-Low

Sl No.	Contents of Module	Hrs	COs
1	Time series - Concept - Components of time Series - Additive and multiplicative models- Measurement of trend – free hand method- semi average method-Moving average method - Least square method.	10	CO1
2	Measurement of seasonal variations - Simple average method - Ratio to trend method-Ratio to moving average method - Link relative method – Variate Differencemethod.	15	CO2
3	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.	10	CO3
4	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.	15	CO4
5	Official Statistics: Statistical System in India CSO and NSSO and their functions – Present structure of the Indian statistical system - Functions of a statistical system – Agricultural statistics - Industrial statistics - Trade statistics - Labour statistics - Transport Communication statistics and Health statistics.	10	CO5

## **Suggested Reading**

### **Books for Study:**

1. Saluja, M.R (1972): Indian official statistical systems: Statistical publishing society, Calcutta and The Indian Econometric Society, Hyderabad.
2. Goon, A.M. Gupta, M.K., and Das Gupta, B. (1980): An outline of statistical theory, Vol.I, 6th revised ed. World Press limited, Calcutta.

### **Books for Reference:**

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



Course Code& Title : 2364208 & Core Practical I  
Course Type : Core

Semester: II  
Credits: 4

**Course outcomes:**

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

(Based on core paper I & II)

Record 40 Marks, Practical Examination 60 Marks

Duration of the Examination: Three Hours

Six questions are to be set without omitting any unit.

Candidates are to answer any four questions.

All questions carry equal marks.

**Course Content:**

1. Construction of Uni-variate and Bi-variate frequency tables (Discrete and Continuous).
2. Diagrammatic representation of data.
3. Graphical representation of data.
4. Computation of measures of central tendency and measures of Dispersion.
5. Computation of measures of Skewness, Kurtosis and Moments.
6. Fitting of straight line, Second degree curve and Exponential and Power curves.
7. Computation of Correlation coefficient (Simple and Bi-variate).
8. Computation of Rank correlation.
9. Computation of Partial and Multiple Correlations.
10. Construction of Simple Regression Equations (Including prediction).
11. Association of attributes - Independence of attributes.
12. Problems based on Addition and Multiplication theorems of Probability
13. Problems based on Bayes' theorem
14. Computation of Marginal and Conditional probability distribution function (discrete random variables).
15. Computation of Marginal and Conditional probability distribution function (continuous random variables).
16. Problems based on Expectations.
17. Problems based on Conditional expectations.
18. Problems based on Covariance and Correlations using expectation.
19. Problems based on Chebychev's inequality.
20. Estimation of mean and variance using Characteristic function.

**Pedagogy**

Assignments/ Seminars / Self-study/ Internship / Field visits / Study tour / Library work  
/ Laboratory / Dissertation

**Policies**

Attendance : As per University of Madras Norms

Evaluation Scheme: (Continuous Assessment / Written test / ~~Minimum marks to pass~~ / ~~Maximum marks~~ / Grading)

## Course Schedules: Practical

Course Code & Title	: 2364209 & Core Practical II	Semester: II
Course Type	: Core	Credits: 2
Credit equivalence	: NA	
Pre-requisites	: NA	

### Course outcomes:

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

1. To know how to clean the data for analysis
2. To do graphical presentation of a data
3. To do Statistical analysis of the data
4. To interpret the data and output of the analysis

(Based on core paper III)

Record 40 Marks, Practical Examination 60 Marks

Duration of the Examination: Three Hours.

Six questions are to be set without omitting any unit. Candidates are to answer any four questions.

All questions carry equal marks.

### Course Content:

1. Enter data / Import data from web and clean data for missing values, repetition, duplication, outliers.
2. Enter data with multiple variables to find basic characteristics of the data- Mean, Median, Mode, Standard deviation, Max, Min,
3. Enter data and identify Outliers and handle it.
4. Data visualization –Diagrams and Graphs.
5. Fitting of mathematical functions and Curve fitting in a data
6. Fitting of Distributions using Excel.
7. Correlation using formula in excel and also using Excel functions.
8. Simple regression model using formula in excel.

Course Code & Title	: 2364419 & Core Practical III	Semester: IV
Course Type	: Core	Credits: 4
Credit equivalence	: NA	
Pre-requisites	: NA	

**Course outcomes:**

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

(Based on core paper VI and VII)

Record 40 Marks, Practical Examination 60 Marks

Duration of the Examination: Three Hours.

Six questions are to be set without omitting any unit.

Candidates are to answer any four questions.

All questions carry equal marks.

**Course Content:**

1. Fitting of Binomial Distribution.
2. Fitting of Poisson distribution.
3. Fitting of Normal Distribution.
4. Test of Hypothesis:  
Power of the test, level of significance.
5. Test of significance
  - i. Mean and variance.
  - ii. Difference of means.
  - iii. Equality of two variances from normal distribution
  - iv. Correlation coefficients.
  - v. Specified proportions.
  - vi. Difference of proportions.
6. Confidence interval for mean and proportion.
7. Test based on Chi-square distribution and F-distribution.

Course Code & Title : 2364633 & Core Practical IV Semester: VI  
Course Type : Core Credits: 4  
Credit equivalence : NA  
Pre-requisites : NA

**Course outcomes:**

1. Applying concept of Simple Random Sampling, X-bar Chart, R Chart,  $\sigma$  chart practically
2. Learn how to applying concepts of Analysis of Variance, design of experiment practically

(Based on core paper XI, XII, XIII, XIV and XVI)

Record 40 Marks, Practical Examination 60 Marks

Duration of the Examination: Three Hours.

Six questions are to be set without omitting any unit. Candidates are to answer any four questions.

All questions carry equal marks.

**Course Content:**

1. Estimation of parameters by the methods of Moments.
2. Estimation of parameters by the methods of MLE.
3. Non-parametric methods :
  - a. Sign test
  - b. Wilcoxon Signed rank test
  - c. Mann Whitney U-test
  - d. Median test
  - e. Test of randomness of sample.
4. Simple Random Sampling.
5. Stratified Random Sampling- Proportional Allocation and Optimum Allocation.
6. Systematic Sampling.
7. X-bar Chart, R Chart,  $\sigma$  chart.
8. p, np and c chart.
9. Analysis of Variance - one-way and two-way.
10. Design of Experiment –CRD, RBD, LSD.
11. Factorial experiments –  $2^2$ ,  $2^3$  experiments with total and partial confounding.
12. Moving average method (3 year and 5 year)
13. Ratio to trend, Ratio to moving average, Link relative method.
14. Fixed and chain base index numbers.
15. Time reversal test, Factor reversal test.
16. Cost of living index numbers.

Course Code & Title : 2364527(A) & Demography Semester: V  
 Course Type : Elective Credits : 5  
 Credit equivalence : NA  
 Pre-requisites : NA

**Course objectives:**

1. To make understand the student of Demographic data, Mortality and Fertility and Life table - Structure
2. Understand the concept of Relationship between function of the life table and Gompertz and Makcham law logistic curve fitting and its use

**Elective Paper I**

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

CO1	To know about concept of Sources of Demographic data.
CO2	To understand the concept of Life table, Mortality and Fertility.
CO3	Explain the concept of Fertility, Measures of fertility, General fertility rate, Specific fertility rate
CO4	Know the Life table - Structure - Construction – Relationship between function of the life Table
CO5	Know the concept of Gompertz and Makcham law logistic curve fitting and its use

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Sources of Demographic data – Civil Registration- Population Census – Population Registers – Errors in Demographic data – Methods of Improvement.	10	CO1
2	Mortality measurements – Merits and Demerits - general and specific rates – standardized rates – age pyramid of sex composition – Ratios, proportions and percentage rates – Population pyramids, sex ratio, crude rate, specific rates, standard rates – direct and indirect.	15	CO2
3	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.	10	CO3
4	Life table - Structure - Construction – Relationship between function of the life table– abridged life table (Concept only)	15	CO4
5	Population estimation and projection, component method of population projection Forces of mortality - Gompertz and Makcham law logistic curve fitting and its use.	10	CO5

**Suggested Reading****Books for Study:**

1. Srivastava, O.S (1983): A text book Demography, Vikas Publishing

**Books for Reference:**

1. Bogue, Donald. J: Principles of Demography, (1976), John Wiley, New York.

Course Code & Title : 2364527(B) & Statistical Applications with R-Language  
 Semester: V Course Type : Elective Credits: 5  
 Credit equivalence : NA  
 Pre-requisites : NA

**Course objectives:**

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

**Elective Paper I**

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

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

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Introduction to R: R as a calculator, statistical software and a programming language, R preliminaries, getting help, data inputting methods (direct and importing from other spread sheet applications like Excel), data accessing, and indexing, Graphics in R, built in functions, saving, storing and retrieving work.	15	CO1
2	Descriptive statistics: diagrammatic representation of univariate and bivariate data (box plots, stem and leaf diagrams, bar plots, pie diagram, scatter plots), measures of central tendency (mean, median and mode), partition values.	10	CO2
3	Measures of dispersion (range, standard deviation, mean deviation and inter quartilerange), summaries of a numerical data, skewness and kurtosis.	10	CO3
4	Correlation- Karl Pearson's co-efficient, Spearman's rank correlation coefficient, Regression Equations - partial and multiple correlation - simple problems.	10	CO4
5	Statistical Inference: classical tests: One- and two-sample tests, z test, t-test, F-test, chi-square test of independence and goodness of fit, interval estimation for mean, difference of mean and variance.	15	CO5

## **Suggested Reading**

### **Books for Study:**

1. Michale J. Crawley (2009), THE R BOOK, John Wiley & Sons, England
2. Sudha G. Purohit (2008), Statistics Using R, Narosa Publishing House, India
3. John Verzani, simple R-Using R for Introductory Statistics,  
([http:// www.math.csi.cuny.edu/Statistics/R/SimpleR/Simple](http://www.math.csi.cuny.edu/Statistics/R/SimpleR/Simple))

### **Books for References:**

1. W. N. Venables, D. M. Smith and the R Core Team (2012), An Introduction to R Notes on R: A Programming Environment for Data Analysis and Graphics, Version 2.15.2  
(<http://www.r-project.org>)

Note: Either one from must be selected from two elective paper for Semester V.



Course Code & Title : 2364631(A) & Stochastic Processes  
 Course Type : Elective

Semester: VI  
 Credits: 4

**Course objectives:**

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

**Core Elective Paper II**

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

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

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	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.	15	CO1
2	Markov chains: Definition and examples of Markov chain, Transition Probability Matrix, classification of states, recurrence concepts, simple problems only. (No Derivations).	15	CO2
3	Basic limit theorem of Markov chain (statement only), stationary probability distribution, and its applications.	10	CO3
4	Continuous Time Markov chain: Pure birth process and Poisson process, Birth and Death process, problems.	10	CO4
5	Branching process: Definition and examples of discrete time branching process, probability generating function, mean and variance, probability of extinction - simple problems.	10	CO5

## **Suggested Readings**

### **Books For Study:**

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

### **Books for Reference:**

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

Course Code & Title : 2364631(B) & Differential Equations, Fourier Series and Fourier Transforms  
 Semester : VI  
 Course Type : Elective Credits: 4  
 Credit equivalence : NA  
 Pre-requisites : NA

**Course objectives:**

1. To obtain the knowledge of Fourier series and transformations, Lagrange's Linear equation – Cauchy – Euler equation
2. Understand the concept of Fourier Transformation – Infinite Fourier transform.( no derivation ) Sine and Cosine Form

**Core Elective Paper II**

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

CO1	To know about concept of Differential Equations.
CO2	To understand the concept of Fourier series and transformations.
CO3	To learned about the Lagrange's Linear equation – Cauchy – Euler equation
CO4	Understand the concept of Fourier Series – Fourier coefficients expansion of function
CO5	To know the Fourier Transformation – Infinite Fourier transform.( no derivation ) Sine and Cosine Form

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	First order and First degree equations of Bernouli – Differential equations of first order and higher degree. Clairaut's equation.	10	CO1
2	Second order differential equations with constant coefficients – Linear operator Dn solution for homogenous equations. Methods of obtaining particular integral for $e^{ax}$ , $x^m$ , $e^{ax}\sin mx$ , $e^{ax}\cos mx$ .	15	CO2
3	Linear homogenous equation – Lagrange's Linear equation – Cauchy – Euler equation and their problems ( no derivation )	10	CO3
4	Fourier Series – Fourier coefficients expansion of function using Fourier series of period 2 Fourier Series for odd and even functions. Half range Fourier series.	10	CO4
5	Fourier Transformation – Infinite Fourier transform (no derivation) Sine and Cosine Form, simple properties and their problems.	15	CO5

**Suggested Readings****Books for Study:**

1. P.Kandasamy K.Thilagavathy K. Gunavathy. Engineering Mathematics Vol3: S.Chand & Co.
2. Dr.S.Sudha Differential Equations and Integral Transforms: Emerald Publishers.

**Books for Reference:**

1. M.K.Venkataraman Engineering Mathematics Vol 3: National Publishing Co.
2. Dr. A. Singaravelu. Transforms and Partial differential equations, Meenakshi agency.

Note: Either one from must be selected from two elective paper for Semester VI.

Course Code & Title : 2364632(A) & Mathematical Economics Semester: VI  
 Course Type : Elective Credits: 4

**Course objectives:**

1. To obtain the knowledge of Mathematical Economics and Economics related to market structure
2. Understand the concept of Cost Analysis – Different types of cost and Mathematical definition of production function

**Core Elective Paper III**

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

CO1	To know the concept of Mathematical Economics
CO2	To learn the important of Economics related to supply and utility.
CO3	To learn about the Cost Analysis – Different types of cost.
CO4	Understand the concept of Market Structure – Definition of Market - Perfect competition - Pure competition.
CO5	To know the Mathematical definition of production function.

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	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	15	CO1
2	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.	10	CO2
3	Cost Analysis – Different types of cost - Total, average and marginal cost functions -Relation between average and marginal costs - Revenue - Total, average and marginal revenue functions and their relationship	10	CO3
4	Market Structure – Definition of Market - Perfect competition - Pure competition - Monopolistic competition and duopolistic competition (Only concept) – Profit maximization – Profit function - Cournot solution to monopoly problem for maximization problem - Joint monopoly and discriminating monopoly - Duopoly - Conjectural variation and reaction curves	15	CO4
5	Theoretical Production functions – Mathematical definition of production function -Constant product curves (Isoquant) - Average and marginal productivity – Homogenous production functions – Properties of linearly homogeneous	10	CO5

	production function – Cobb-Douglas production function – C. E. S. production function.		
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**Suggested**

**Readings Books**

**for Study:**

1. Mehta and Madhnani (2001): Mathematics for Economists, Sultan Chand,
2. R.G.D.Allen(1976) Mathematical Analysis for Economists,Macmillian

**Books for Reference:**

- 1) Varma and Agarwal (1998): Managerial Economics, Sultan Chand and Company, New Delhi.
- 2) R.G.D. Allen Mathematics for Economics.
- 3) Varshney and Maheswari Managerial Economics
- 4) K.P. M.Sundaram Busniess Economics
- 5) Dr. S. Shankarn Managerial Economics.

Course Code & Title : 2364632(B) & International Trade

Semester: VI

Course Type : Elective

Credits: 4

**Course objectives:**

1. To impart the knowledge of International Trading and import and export management
2. To obtain the knowledge of International economics organization and World trade organization and Tradeliberalization

**Core Elective Paper III**

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

CO1	To know the concept of International Trading
CO2	To learn about import and export management
CO3	Important of World trade organization and International economics organization
CO4	Understand the concept of International economics organization and its functions –International Monetary Fund(IMF)
CO5	To know the (WTO) World trade organization and Trade liberalization – Liberalizationof Trade in manufacturing

**Mapping of CO with PO &PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	International Trade- Importance of International Trade – Theories of Foreign Trade – Theories of Adam Smith, Ricardo, Haberler, Heckscher.	10	CO1
2	Balance of Trade – Balance of Concept – Causes of Disequilibrium – Method of Correct Disequilibrium – Fixed and Floating exchange rates – Euro – Dollar market.	10	CO2
3	Export Management – Export procedure and document – Export finance – Export promotions- Export pricing.	10	CO3
4	International economics organization and its functions – International Monetary Fund(IMF),- International Bank for Reconstruction and Development (IBRD)[World Bank] – International Development Association (IDA)-International Finance Corporation (IFC) – Asian Development Bank(ADB) – United Nations Conference on trade and Development (UNCTAD) – United Nations Industrial development organization (UNIDO).	15	CO4
5	(WTO) World trade organistaion and Trade liberalistation – Liberalistion of Trade in manufacturing and in Agricultural trade – (TRIPS) Trade related intellectual	15	CO5

	property Rights – Trade related Investment Measures (TRIMS) – Indian patent Law.		
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### **Suggested Readings**

#### **Books for Study:**

- 1) Francis Cherunilam, International Trade and Export Management, Himalaya Publishing House 2003.
- 2) Dr. S. Sankaran, International Economics, Margham Publications.

#### **Books for References:**

- 1) B. Santhanam, International Trade and Foreign Exchange, Margham Publications.
- 2) Paul K. Krugman and Mourice, International Economics.
- 3) Robert J. Karbough, International Economics.

Note: Either one from must be selected from two elective paper for Semester VI.



Course Code& Title : 2364102 & Mathematics for Statistics Semester: I  
 Course Type : Allied Credits: 5  
 Credit equivalence : NA  
 Pre-requisites : NA

**Course objectives:**

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

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

CO1	Know the role of reciprocal equations in theory of equations.
CO2	Obtain the characteristic roots and vectors and C-H Theorem
CO3	To obtain the knowledge of differentiations and its types
CO4	To learned about successive differentiations
CO5	To learned about Properties of definite integrals – Reduction formula – Bernoulli's formula

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	Cos
1	Matrix theory-definition and type of matrices, scalar, Elementary, Symmetric, Skew Symmetric, Hermitian, Skew - Hermitian, independent and unitary matrices- algebraic operations on matrices and their properties-elementary transformations of matrices – determinant of matrix, definition of a row rank– column rank and rank of a matrix – determination of rank of a matrix.	15	CO1
2	Inverse of a square matrix – Singular matrix- computation of the inverse of the square matrix - solution of linear equations – Homogenous and non-homogenous systems of equations–solutions space – consistency characteristic equations– root and vectors of a square matrix – left and right eigen vectors – Cayley –Hamilton theorem and Reducing quadratic form to canonical form by orthogonal transformation.	15	CO2
3	Logarithmic differentiation, Differentiation of implicit functions, Concavity, Convexity –Points of inflexion – Euler's Theorem - Total differential coefficients (proof not needed ) –Simple problems only.	10	CO3
4	Successive differentiation – Leibnitz theorem – Partial Differentiation – Maxima and Minima of functions of two variables.	10	CO4
5	Integration – Properties of definite integrals – Reduction formula – Bernoulli's formula- Beta and Gamma integration.	10	CO5

**Suggested Readings****Books for Study:**

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

**Books for Reference:**

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

Course Code& Title : 2364207 & Real Analysis  
 Course Type : Allied

Semester: II  
 Credits: 5

**Course objectives:**

1. To make understand the student about function, limit and continuity concepts
2. To obtain the knowledge of convergence, divergence. Continuity and Riemann integral
3. To obtain the knowledge of Laplace transforms and inverse Laplace transforms

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

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

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Sets, Operations on sets – real valued functions – countability – real numbers bounds, supremum and infimum – sequence of real numbers – limit inferior and limit superior and limits of real sequences– limit theorems.	10	CO1
2	Convergence and divergence of a series –Geometric series –simple tests for convergence of a Series (Comparison tests, ratio test, root test, Leibnitz test) – conditional convergence and absolute convergence of alternating series – Simple problems.	10	CO2
3	Continuous function and its properties – (Simple theorems only) – Uniform Continuity – Rolle's Theorem – Mean Value Theorem – Taylor's Theorem – Maclaurin Series.	15	CO3
4	Riemann integrals, sufficient condition for Riemann integrability, Darboux theorem, fundamental theorem of integral calculus – first mean value theorem.	15	CO4
5	Laplace transformation (LT) – definitions, LT of the function $t$ , $e^{at}$ , $\cos at$ , $\sin at$ , $e^{at} \cos bt$ , $e^{at} \sin bt$ , transform $f'(t)$ , $f''(t)$ - Inverse LT relating to the above standard functions.	10	CO5

## **Suggested Readings**

### **Books for Study:**

1. D.Somasundram and B.Choudhary (2002): A first course in Mathematical Analysis, Narosa Publishing house.
2. Gold berg, R.R (1970): Method of Real Analysis, Oxford and IBH.

### **Books for Reference:**

1. Narayanan and T. K. Manickavachagam Pillai – Ancillary Mathematics Book II
2. Bartle R. G &Shebert, D. R. (1982): Introduction to Real Analysis, Wiley Eastern & Sons.
3. Bartle, R.G.Real 1976. Analysis, John Wiley and sons Inc.,
4. Malik, S.C. and Savita Arora (1991). Mathematical Analysis, Wiley Eastern Limited. New Delhi,
5. Sanjay Arora and Bansi (1991). Introduction to Real analysis, Satya Prakashan, New Delhi.
6. W. Rudin (1976): Principles of Mathematical Analysis, 3/e, McGraw Hill Company.

Course Code & Title : 2364313 & C- Language Programming  
 Course Type : Allied

Semester : III  
 Credits : 3

**Course objectives:**

1. To impart the knowledge of big data using c programming and mean and variance using C program
2. To obtain the knowledge of Pointer expressions and learn the statements of C language.

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

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

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Introduction to “C”, variables, data types - declarations, type conversions, increment and decrement, Bitwise, Logical and Assignment operators.	10	CO1
2	Expression and conditional expressions, control structures, IF-ELSE, SWITCH, WHILE, FOR and DO WHILE loop structures. Break continue, GO and Lable statements. Function, function returning, Non-integers, Function arguments-Static and register variables.	15	CO2
3	Arrays and strings – Array Declaration, Multidimensional Arrays- Strings / character Arrays, Array initialization – Pointers and addresses. Pointers and Arrays – Pointers to function.	15	CO3
4	Standard input and output – formatted output – output – Access to the standard library.	10	CO4
5	File Access, File handling in C-File descriptions - Error handling - Low level i/o- Read and Write. Open, Create, Close, Unlike and random access files.	10	CO5

**Suggested Readings**

**Books For Study:**

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

**Books for Reference:**

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

Course Code & Title : 2364418 & Numerical Methods  
 Course Type : Allied  
 Credit equivalence : NA  
 Pre-requisites : NA

Semester: IV  
 Credits: 4

**Course Objectives:**

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

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

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

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Simultaneous equations: Direct methods: Gauss Elimination method- Gauss-Jordan method. Iteration methods: Gauss-Jacobi method- Gauss Seidel method.	15	CO1
2	Finite differences-forward and backward differences, operators E and $\Delta$ , and their basic properties, Interpolation with equal intervals: Newton's forward and backward differences-simple problems.	10	CO2
3	Central difference interpolation formula-Gauss forward and backward differences formulae – Stirling's, Besse's and Laplace- Everett's formulas-simple problems only.	10	CO3
4	Interpolation with unequal intervals: Divided differences and their properties, Newton's divided differences formula- Lagrange's formula- simple problems. Inverse interpolation: Iteration or successive approximation method- Lagrange's method-simple problems	10	CO4
5	Numerical differentiation: Numerical Derivatives upto 2 <sup>nd</sup> order (equal intervals only)-simple problems. Numerical integration: Trapezoidal rule – Simpsons 1/3 <sup>rd</sup> and 3/8 <sup>th</sup> rules – Weddle's rule – Euler's summation formula.	15	CO5

## **Suggested Readings**

### **Books for Study:**

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

### **Books for Reference:**

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

Course Code & Title : 2364314 & Programming in C  
Course Type : Allied Practical I  
Credit equivalence : NA  
Pre-requisites : NA

Semester: III  
Credits: 2

**Course outcomes:**

Understand concept of Matrices and other topics through this C programming language

**Course Content:**

1. Summation of Series:
  - a. Sin(x), 2. Cos(x), 3. Exp(x) (Comparison with built in functions)
2. String Manipulation:
  - a. Counting the no. of vowels, consonants, words, whitespaces in a line of text and array of lines
  - b. Reverse a string & check for palindrome.
3. Matrix Manipulation:
  - a. Addition, Subtraction & Multiplication
  - b. Transpose and trace of a matrix
4. Calculate the value of  $\Pi$  (up to five decimal places).
5. Generation of Fibonacci sequence.
6. Calculate the value of binomial co-efficient.



Course Code & Title	: 2364420 & Numerical Methods with C Programming	Semester: IV
Course Type	: Allied Practical II	Credits: 2
Credit equivalence	: NA	
Pre-requisites	: NA	

**Course outcomes:**

Learn about how to find solution of Trapezoidal, Simpson's and Weddle's rules using C language program.

**Course Content:**

1. Newton's backward interpolation.
2. Newton's forward interpolation.
3. Lagrange interpolation.
4. Numerical integration by Trapezoidal rules.
5. Numerical integration by Simpson's rules.
6. Numerical integration by Weddle's rules.
7. Numerical ordinary differential equations by Taylor's method.
8. Numerical ordinary differential equations by Euler method.
9. Numerical ordinary differential equations by Runge Kutta second order method.

Course Code& Title  
Credits: 2

: Value Education

Semester: V

**Course objectives:**

1. To acquire the knowledge of value are socially accepted norms to e valuate objects, persons.
2. To obtain the knowledge of set of consistent values and measures.
3. To understand the importance of “People should be treated with respect and dignity

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

CO1	Understand the Value are socially accepted norms to e valuate objects, personsand situations that form part and parcel of sociality
CO2	Learn about a value system is a set of consistent values and measures. Knowledge of the values are inculcated through education.
CO3	To know the concept of “Equal rights for all”, “Excellence deserves admiration”
CO4	Understand the importance of “People should be treated with respect and dignity”. Values tend to influence attitudes
CO5	Understand the concepts of values are related to the norms of a culture.

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Value education-its purpose and significance in the present world – Value system – The role of culture and civilization – Holistic living – balancing the outer and inner – Body, Mind and Intellectual level – Duties and responsibilities.	10	CO1
2	Salient values for life – Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, and inclusiveness, Self esteem and self confidence, punctuality – Time, task and resource management – Problem solving and decision making skills – Interpersonal and Intra personal relationship – Team work – Positive and creative thinking.	15	CO2
3	Human Rights – Universal Declaration of Human Rights – Human Rights violations – National Integration – Peace and non-violence – Dr.A P J Kalam’s ten points for enlightened citizenship – Social Values and Welfare of the citizen – The role of media in value building.	15	CO3
4	Environment and Ecological balance – interdependence of all beings – living and non-living. The binding of man and nature – Environment conservation and enrichment.	10	CO4
5	Social Evils – Corruption, Cyber crime, Terrorism – Alcoholism, Drug addiction – Dowry – Domestic violence – un touchability – female infanticide – atrocities against women – How to tackle them.	10	CO5

**Books for Reference:**

1. M.G. Chitakra: Education and Human Values, A.P.H. Publishing Corporation, New Delhi, 2003.
2. Chakravarthy, S.K: Values and ethics for Organizations: Theory and Practice, Oxford University Press, New Delhi, 1999.
3. Satchidananda, M.K: Ethics, Education, Indian Unity and Culture, Ajantha Publications, Delhi, 1991.
4. Das, M.S. & Gupta, V.K.: Social Values among Young adults: A changing Scenario, M.D. Publications, New Delhi, 1995.
5. Bandiste, D.D.: Humanist Values: A Source Book, B.R. Publishing Corporation, Delhi, 1999.
6. Ruhela, S.P.: Human Values and education, Sterling Publications, New Delhi, 1986.
7. Kaul, G.N.: Values and Education in Independent Indian, Associated Publishers, Mumbai, 1975.
8. NCERT, Education in Values, New Delhi, 1992.
9. Swami Budhananda (1983) How to Build Character A Primer : Rmakrishna Mission, New Delhi.
10. A Culture Heritage of India (4 Vols.), Bharatiya Vidya Bhuvan, Bombay, (Selected Chapters only)
11. For Life, For the future : Reserves and Remains – UNESCO Publication.
12. Values, A Vedanta Kesari Presentation, Sri Ramakrishna Math, Chennai, 1996.
13. Swami Vivekananda, Youth and Modern India, Ramakrishna Mission, Chennai.
14. Swami Vivekananda, Call to the Youth for Nation Building, Advaita Ashrama, Calcutta.
15. Awakening Indians to India, Chinmayananda Mission, 2003.

The Statistics offering NME for UG Degree:

NON MAJOR ELECTIVE PAPER I

Course Code & Title : 2364103/ BASICS OF STATISTICS Semester: I  
 Course Type : NME Credits: 2

**Course objectives:**

1. To acquire the knowledge of uses of statistics in society
2. To obtain the knowledge of organize, manage and present data

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

CO1	Know the uses of statistics in society
CO2	Organize, manage and present data

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Definition of statistics- limitations of statistics – data Types- complete enumeration, observational studies and sample surveys-Presentation by tables and diagrams- Measures of Locations –Measures of Dispersion – Simple Problems.	15	CO1
2	Correlation- Scatter diagram, Karlpearson’s co-efficient and its properties, Spearman'srank correlation coefficient, principle of least squares and fitting of first curve- Regression Equations- properties of regression equations, regression lines and conceptof error in regression - partial and multiple correlation- concepts. Association of attributes and simple problems.	15	CO2

Suggested Readings

Books for Study:

- 1) Dr.P.R.Vital (2018)-Mathematical Statistics , Margham Publications.
- 2) SP Gupta (1976) - Statistical Methods - Sulta chand & Sons .

Course Code & Title : 2364210/ BASICS OF PROBABILITY Semester: II  
 Course Type : NME Credits: 2

**Course objectives:**

1. To acquire the knowledge of real life data and translate real-world problems into probability models.
2. To understand the concept of basic probability rules, including additive and multiplicative laws

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

CO1	Identify random experiments in real life data and translate real-world problems into probability models.
CO2	Understand the use of basic probability rules, including additive and multiplicative laws, independent and mutually exclusive events.

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Definition of Probability, Axioms on Probability, Random Experiment, Sample Points and Sample Space. Event and Operations on events. Classical and relative frequency approach to probability-Axiomatic approach to probability and simple problems.	15	CO1
2	Addition theorem of Probability –Conditional Probability, Independence of events-Multiplication theorem-Bayes’ Theorem (without Proof) Simple problems-Discrete and Continuous Random Variable - simple problems (Related to Discrete Random Variable Problems only)	15	CO2

Suggested Readings

Books for Study:

1. P.R.Vital : Mathematical Statistics, Margham Publications.
2. K.L. Chung (1983) : Elementary Probability theory with stochastic processes, Springer International student edition.

## **Courses offered to B. SC., DATA SCIENCE**

### **SCHEME OF EXAMINATIONS**

#### **B.Sc. Data Science – I, II, III, IV SEMESTERS**

<b>Course Components/Title of the paper</b>	<b>Credits</b>	<b>MARKS</b>		
		<b>CIA</b>	<b>EXT</b>	<b>TOTAL</b>
<b>Statistical Methods and Its Applications</b>	5	50	50	100
<b>Probability and Statistics</b>	5	50	50	100
<b>Optimization Techniques</b>	5	50	50	100
<b>Statistical Analysis Using R</b>	5	50	50	100
<b>Total</b>	20	200	200	400

**Code & Title : 2364104 & Statistical Methods and Its Applications**

**Semester : I**

**Course Type: Allied**

**Credits: 5**

**Course Objectives:**

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

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

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

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Nature and Scope of Statistical Methods and Their Limitations – Collection, Classifications, Tabulation and Diagrammatic Representation of various types of statistical data - Frequency Curves and Ogives - Graphical determination of percentiles quartiles and their properties - Merits and Demerits.	12	CO1
2	Measures of Location: Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean and their properties - Merits and Demerits - Simple Problems.	12	CO2
3	Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation, Skewness and Kurtosis and their properties - Simple Problems.	12	CO3
4	Correlation -Scatter diagram, Karl Pearson's, Spearman's rank and Concurrent deviation methods, Partial and Multiple correlation – Definition with example.	12	CO4
5	Regression Analysis: Regression Lines, Regression equations, Regression Coefficients, Properties of regression coefficients – Simple Problems. Curve fitting – Principle of Least squares – Fitting of first degree and second degree polynomial – Power curve & Exponential curve – Simple problems	12	CO5

#### REFERENCES

1. Gupta, S.C and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2002.
2. Freund J.E (2001): Mathematical Statistics, Prentice Hall of India.
3. Goon A.M., Gupta M.K., Das Gupta.B. (1991): Fundamentals of Statistics, Vol.I, World Press, Calcutta.
4. Hodges J.L and Lehman E.L (1964): Basic Concepts of Probability and Statistics, Holden Day.
5. Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.

#### ADDITIONAL REFERENCES

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



**Code & Title : 2364211 & Probability and Statistics**

**Semester : II**

**Course Type: Allied**

**Credits: 5**

**Course Objectives:**

- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables and standard distributions.
- To familiarize the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays an important role in real life problems.

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

CO1	Students know the basic concept of Probability, Random variables and mathematical expectations.
CO2	Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables.
CO3	Students Know some discrete and continuous distributions.
CO4	Students Know knowledge of point estimation and testing of hypothesis for small and large samples which plays an important role in real life problems.
CO5	Students Know the basic concepts of design of experiments which plays an important role in real life.

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	<b>Probability and random variables:</b> Probability of an event- finitely additive probability space addition and multiplications theorems- Independence of events- Conditional Probability – Bayes Theorem, Concept of Random variable- Mathematical expectation-Moments of random variable(raw and central moments) – Moment generating function..	12	CO1
2	<b>Two Dimensional Random Variables:</b> Joint distributions – Marginal and conditional distributions – covariance- correlation and linear regression- Transformation of random variables – Central limit theorem (for independent and identically distributed random variables) - Simple Problems.	12	CO2
3	<b>Discrete and Continuous Distributions:</b> Binomial, Poisson and fitting of these distributions, Geometric, Uniform, exponential and Normal distributions and simple problems.	12	CO3
4	<b>Testing of Hypothesis:</b> Concept of point Estimation with properties – Large sample tests based on Normal distribution for mean, variance and proportion. Tests based on t, Chi square and F distributions - Contingency table (test for independent) – simple problems.	12	CO4
5	<b>Design of Experiments:</b> Basic principles of design of experiments - randomization, replication, and local control, Analysis of variance - One way and two way classification Analysis of CRD and RBD - Latin square designs – simple problems.	12	CO5

#### REFERENCES:

1. Gupta, S.C and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2002.
2. Gupta. S. C. and Kapoor. V. K., “Fundamentals of Applied Statistics” (2nd edition – 1978), Sultan Chand & Sons, New Delhi.
3. Freund John, E and Miller, Irvin, “Probability and Statistics for Engineering”, 5th Edition, Prentice Hall, 1994.
4. Jay, L. Devore, “Probability and Statistics for Engineering and Sciences”, Brooks Cole Publishing Company, Monterey, California, 1982.
5. Montgomery D.C and Johnson, L.A, “Forecasting and Time series”, McGraw Hill.
6. Anderson, O.D, “Time series Analysis: Theory and Practice”, I.North-Holland, Amsterdam, 1982.



Sl No.	Contents of Module	Hrs	COs
1	<b>Linear Models:</b> Introduction of Operations Research - mathematical formulation of LPP- Graphical Methods to solve LPP- Simplex Method- Big M method, Two-Phase method.	12	CO1
2	<b>Transportation and Assignment Problems:</b> Transportation problems- obtaining initial feasible and optimal solutions, optimality test, unbalanced transportation problems. Assignment problems and unbalanced assignment problems- Travelling salesman problems.	12	CO2
3	<b>Project Scheduling:</b> Project network -Diagram representation – Floats - Critical path method (CPM) – PERT- Cost considerations in PERT and CPM.	12	CO3
4	<b>Game Theory:</b> 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.	12	CO4
5	<b>Queuing Models:</b> Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituents of a Queuing system, Service facility, Queue discipline, Single channel with finite and infinite capacity models.	12	CO5

**TEXT BOOK:**

1. Hamdy A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2017.

**REFERENCES:**

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

**Code & Title : 2364422 & Statistical Analysis Using R**  
**Semester : IV Course Type: Allied**

**Credits: 5**

**Course objectives:**

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

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

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

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	Cos
1	<b>Introduction to R:</b> R as a calculator, statistical software and a programming language, R preliminaries, getting help, data inputting methods (direct and importing from other spread sheet applications like Excel), data accessing or indexing, Graphics in R, built in functions.	15	CO1
2	<b>Descriptive statistics:</b> Diagrammatic representation of data (box plots, bar plots, pie diagram, scatter plots, histogram, spike graph, frequency polygon, Ogives), preparation of frequency distribution. <b>Measures of central tendency:</b> Mean, median, mode, geometric mean and harmonic mean, partition values.	10	CO2
3	<b>Measures of dispersion:</b> Range, quartile deviation, mean deviation, standard deviation, variance, coefficient of variation and summaries of a numerical data. Measures of skewness and kurtosis, <b>Correlation and Regression:</b> Karl Pearson's co-efficient, Spearman's rank correlation coefficient, Regression Equations.	10	CO3
4	<b>Probability and Distributions:</b> Discrete and continuous random variables – Probability mass and density functions, cumulative distribution function. Discrete distributions: Binomial distribution, Poisson distribution, hyper geometric distribution. Continuous distributions: Normal Distribution, Plots to check Normality, Exponential distribution.	10	CO4
5	<b>Inferential Statistics:</b> classical tests: One- and two-sample tests, z test, t-test, F-test, chi-square test of independence and goodness of fit, interval estimation for mean, difference of mean and variance. ANOVA (one- way and two-way).	15	CO5

## REFERENCES

1. Michale J. Crawley, THE R BOOK, John Wiley & Sons, England (2009)
2. Sudha G. Purohit et.al., Statistics Using R, Narosa Publishing House, , India(2008)
3. John Verzani, simple R-Using R for Introductory Statistics,  
(<http://www.math.csi.cuny.edu/Statistics/R/SimpleR/Simple.>)
4. W. N. Venables, D. M. Smith and the R Core Team, An Introduction to R , Notes on R: A
5. Programming Environment for Data Analysis and Graphics, Version 2.15.2  
(2012-10-26)  
(<http://www.r-project.org>)  
<https://christopencourseware.com/course/Statistical+Analysis+using+R>

## **Courses offered to B. Sc., Computer Science**

### **SCHEME OF EXAMINATIONS**

#### **B.Sc. Computer Science – III, IV SEMESTERS**

<b>Course Components/Title of the paper</b>	<b>Credits</b>	<b>MARKS</b>		
		<b>CIA</b>	<b>EXT</b>	<b>TOTAL</b>
<b>Statistical Methods for Computer Science – I</b>	5	50	50	100
<b>Statistical Methods for Computer Science – II</b>	5	50	50	100
<b>Total</b>	10	100	100	200

**Code & Title : 2364315 & Statistical Methods for Computer Science – I**  
**Semester : III Course Type: Allied**

**Credits: 5**

**Course objectives:**

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

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

CO1	How to collection, classification of the data and its limitations and how to resent/compare the data using diagrams and graphs.
CO2	Evaluate Measures of locations and Measures of dispersion.
CO3	Evaluate Karl Pearson's, Bowley's, Kelly's Coefficient of Skewness. Kurtosis based on Moments.
CO4	Evaluate correlation and Regression analysis.
CO5	Evaluate Curve fitting: Straight line, Second degree equation, Power Curve and Exponential Curves.

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**



Sl No.	Contents of Module	Hrs	COs
1	Introduction – Scope and limitations of Statistical methods – Classification of data – Tabulation of data – Diagrammatic and Graphical representation of data – Graphical determination of Percentiles and Quartiles.	12	CO1
2	Measures of locations, Measures of dispersion – Absolute and Relative measures	12	CO2
3	Measures of Skewness: Karl Pearson's, Bowley's, Kelly's Coefficient of Skewness. Kurtosis based on Moments.	12	CO3
4	Correlation: Scatter diagram, Karl Pearson's, Spearman's rank and Concurrent deviation methods. Regression Analysis: Simple regression equations.	12	CO4
5	Curve fitting by the method of least squares: Straight line, Second degree equation, Power Curve and Exponential Curves.	12	CO5

### Text Books:

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

### Reference Books:

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

**Code & Title : 2364421 & Statistical Methods for Computer Science– II**

**Semester : IV**

**Course Type: Allied**

**Credits: 5**

**Course objectives:**

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

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

CO1	Understand the basics of Probability and Baye’s theorem.
CO2	To solve the problems of PDF, PMF and expectation of probability
CO3	Evaluate the distributions of binomial, Poisson and Normal.
CO4	Evaluate the testing of hypothesis large samples and small samples test
CO5	Analysis and evaluate the Randomization, Replication and Local Control – CRD, RBD and LSD.

**Mapping of CO with PO & PSO:**

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

**3-Strong 2-Medium 1-Low**

Sl No.	Contents of Module	Hrs	COs
1	Sample Space – events – definition of Probability, Addition and Multiplications theorems – simple problems. Conditional probability – Baye’s theorem (proof only).	12	CO1
2	Concept of Random Variable – Probability mass function, Probability density function and Distribution function. Mathematical Expectation: Properties of expectations, Chebychev’s inequality (only theorem).	12	CO2
3	Standard distributions: Binomial (mean and variance) Poisson (mean and variance) and fitting of these distributions. Normal distributions (characteristics and area problems)	12	CO3
4	Concept of Sampling distributions – Standard Error – Tests of Significance based on t, Chi –Square and F distributions with respect of Mean, Variance and Correlation coefficient. Chi – Square test for independence of attributes. Goodness of fit. Large sample test based on Mean and Proportions.	12	CO4
5	Analysis of Variance: One way and two way classifications. Basic principles of design of experiments: Randomization, Replication and Local Control – CRD, RBD and LSD.	12	CO5

**Text Books:**

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

**Reference Books:**

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