# DEPARTMENT OF STATISTICS

CHOICE BASED CREDIT SYSTEM (CBCS)
Learning Outcome-based Curriculum Framework (LOCF)
SYLLABUS

## Bachelor of Science

2023 - 2024

MADRAS CHRISTIAN COLLEGE
(AUTONOMOUS)
College with Potential for Excellence
Affiliated to University of Madras
Tambaram
Chennai – 600 059

MADRAS CHRISTIAN COLLEGE

# VISION

Madras Christian College aspires to be an Institution of excellence transforming lives through education with a commitment to service.

# MISSION

Madras Christian College (MCC) with the inspiration of the love of God offers to people of all communities education of the whole person, which is congruous with God's revelation in Christ of the true nature of humanity and is appropriate to the needs of India and of the world.

# Graduate Attributes

The Madras Christian College defines the philosophy underpinning its academic programmes and student life experience on campus through the Graduate Attributes (GA), that describe the knowledge, competencies, values and skills students imbibe for holistic development and contribution to society. These attributes encompass characteristics that are transferable beyond the domain of study into the national and international realm fostered through curricular, co-curricular and extra-curricular engagements.

## GA 1: Intellectual Competencies

- Graduates of MCC have a comprehensive and incisive understanding of their domain of study as well as the capability for cross-disciplinary learning.
- They have the ability to apply the knowledge acquired through the curriculum as well as self-directed learning to a broad spectrum ranging from analytical thinking to synthesise new knowledge through research.
- Forming independent individual opinions regarding academic cores and socially relevant issues

## GA 2: Professional Ethics

- Graduates of MCC develop ethical and professional behaviour, which will be demonstrated in their chosen careers and constructive citizenship roles.
- They imbibe intellectual integrity and ethics in scholarly engagement and develop a spirit of inclusiveness through interactions with people of special needs and diversity.

## GA3: Leadership Qualities

- Graduates of MCC inculcate leadership qualities & attitudes, and team behaviour along democratic lines through curricular, co-curricular and extra-curricular activities
- They develop managerial and entrepreneurial skills to ideate and create new opportunities along with career readiness and capacity to take up various competitive exams.

**GA 4: Holistic Skill Development**

- Graduates of MCC develop critical thinking, problem-solving, effective communication, emotional and social skills
- They develop digital competency to live, learn and serve in society.

**GA 5: Cross-Cultural Competencies**

- Graduates of MCC imbibe cross-cultural competencies through engaging with diverse linguistic, ethnic and religious communities providing scope to understand, accept and appreciate individuals at local, national and international levels.
- They develop a global perspective through contemporary curriculum, culture, language and international exchange programmes

**GA 6: Service-Oriented Focus**

- Graduates of MCC have sensitivity to social concerns and a conviction toward social justice through a commitment to active social engagement.
- They are endowed with a strong sense of environmental awareness through the curriculum and campus eco-system.

**GA 7: Value-Based Spiritual Development**

- Graduates of MCC are rooted in the principles of ethical responsibility and integrity permeated with Christian values leading to the building of character.
- They develop virtues such as love, courage, unity, brotherhood, industry and uprightness.

**Programme Outcomes**

Programme Outcomes (POs) of Madras Christian College define the minimum level that students are expected to do, achieve and/or accomplish in order to graduate from a particular programme. These Outcomes are a framework to assess the nature of learning activity experienced within the programme.

**POs for Under Graduate Programmes**

**UG Programmes are designed to have the following outcomes:**

**On successful completion of the Undergraduate programme, the students will be able to**

| **PO** | PO | Descripton of PO | Mappedwith GA |
|---|---|---|---|
| PO 1 | Language Skills | • Demonstrate oral and written skills to effectively communicate in English and Languages of their choice<br>• Apply reading and listening skills to facilitate access to knowledge resources and understanding | GA1, GA4, GA5 |
| PO 2 | Domain Knowledge | • Acquire knowledge of basic concepts, theories and processes through study of core courses in respective programmes<br>• Apply and Analyze domain specific knowledge to emerging areas of academia and industry<br>• Assess, adapt and develop domain specific transferrable skills to new/unfamiliar context | GA1, GA3, GA4, GA5 |
| PO 3 | Interdisciplinary knowledge | • Identify and determine relationships across disciplines<br>• Acquire and apply | GA1, GA4 |

| | | | |
|---|---|---|---|
| | | interdisciplinary knowledge for holistic academic development | |
| PO 4 | Digital Skills | • Acquire computer skills and their application relevant to classroom and self-directed web-based learning<br>• Familiarize with and use domain-related software resources, computational skills and digital tools for data analysis, visualization and interpretation<br>• Ethically apply digital skills to creatively communicate a wide range of ideas and issues related to academic experiences | GA1, GA2, GA3, GA4, GA6 |
| PO 5 | Analytical skills | • Develop the ability to think critically and relate learning to academic, professional and real-life problem solving<br>• Apply empirical knowledge and skills to identify and collect quantitative and qualitative data to analyze and formulate evidence-based suggestions and solutions | GA1, GA2, GA4, GA6 |
| PO 6 | Academic writing & Presentation skills | • Formulate and document results obtained in laboratory, case studies, project work, field work and internships<br>• Effectively communicate through engaging presentations | GA1, GA4, GA5 |

| | | | |
|---|---|---|---|
| | | using methodologies appropriate to the discipline | |
| PO 7 | Innovation and Creativity | • Demonstrate transferable capabilities and intrapreneurial skills that are relevant to the industry and other employment opportunities<br>• Develop entrepreneurial skills and generate intellectual property | GA1, GA2, GA3 |
| PO 8 | Social Engagement and Responsibility | • Demonstrate the ability to link classroom learning with social concerns through service learning and outreach programmes.<br>• Enhance positive personality traits to adapt to changing circumstances and demonstrate leadership qualities as an individual and a member of cross-cultural and multi-disciplinary teams.<br>• Appreciate environmental consciousness and sustainability<br>• Draw valuable insights from one's own spiritual tradition and that of others for peaceful coexistence and general wellbeing | GA1, GA2, GA5, GA6, GA7 |

## PROGRAM SPECIFIC OUTCOMES (PSO's)

At the time of under graduation they would be able to:

| PSO | Statement | Mapped with PO |
|---|---|---|
| **PSO1** | Understanding the Mathematical and Theoretical foundations of Statistics | **PO2** |
| **PSO2** | Acquiring skills to statistically model the problem and validate the model | **PO2, PO5, PO6, PO7** |
| **PSO3** | Identifying the statistical tools appropriate for the problem and analyzing using statistical software | **PO4, PO5, PO7** |
| **PSO4** | Interpreting results and drawing conclusions relevant to the field | **PO3, PO6, PO7** |
| **PSO5** | Enabling the students to pursue Master Degree in other disciplines such Data science and Data analytics, Business Administration, Computer Applications etc., in addition to Statistics and contribute to the development in Statistics | **PO3, PO8** |

## Curriculum Template for (B.Sc. Statistics)(Effective from 2023-24)

| Semester | Part | Course code | Course title | Instruction hours per Cycle | Duration of exam (in hours) | Marks | | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ICA | ESE | Total | |
| I | I | | Language-I | 4 | 3 | 50 | 50 | 100 | 3 |
| | II | | English-I | 4 | 3 | 50 | 50 | 100 | 3 |
| | III | 231ST1M01 | Descriptive Statistics | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | 231ST1M02 | Mathematics for Statistics | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | 231ST2M03 | Major Practical - I | 2 | - | - | - | - | - |
| | III | 231ST1A01 | Demography | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | 231ST2A02 | Allied Practical - I | 2 | 3 | - | - | - | - |
| | IV | 231ST1G01 | Introductory Statistics | 4 | 3 | 50 | 50 | 100 | 2 |
| | IV | | Value Education-I | 2 | 3 | 50 | 50 | 100 | 1 |
| II | I | | Language-II | 4 | 3 | 50 | 50 | 100 | 3 |
| | II | | English-II | 4 | 3 | 50 | 50 | 100 | 3 |
| | III | 231ST2M01 | Matrix Algebra | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | 231ST2M02 | Probability and Random Variables | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | 231ST2M03 | Major Practical – I | 2 | 3 | 50 | 50 | 100 | 2 |
| | III | 231ST2A01 | Numerical Analysis | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | 231ST2A02 | Allied Practical - I | 2 | 3 | 50 | 50 | 100 | 2 |
| | IV | 231ST1G01 | Introductory Statistics | 4 | 3 | 50 | 50 | 100 | 2 |
| | IV | | Value Education-II | 2 | 3 | 50 | 50 | 100 | 1 |
| III | I | | Language-III | 4 | 3 | 50 | 50 | 100 | 3 |
| | II | | English-III | 4 | 3 | 50 | 50 | 100 | 3 |
| | III | | Real Analysis | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | | Distribution Theory | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | | Major Practical - II | 2 | - | - | - | - | - |
| | III | | Programming in C | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | | Allied Practical – II | 2 | - | - | - | - | - |
| | IV | | Actuarial Statistics | 4 | 3 | 50 | 50 | 100 | 3 |
| | IV | | Personality Development | 2 | - | - | - | - | - |
| IV | I | | Language-IV | 4 | 3 | 50 | 50 | 100 | 3 |
| | II | | English-IV | 4 | 3 | 50 | 50 | 100 | 3 |
| | III | | Theory of Estimation | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | | Sampling Techniques | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | | Major Practical - II | 2 | 3 | 50 | 50 | 100 | 2 |
| | III | | Data Analysis using SPSS and SQL | 4 | 3 | 50 | 50 | 100 | 4 |
| | III | | Allied Practical – II | 2 | 3 | 50 | 50 | 100 | 2 |
| | IV | | Environmental Studies | 4 | 3 | 50 | 50 | 100 | 2 |
| | IV | | Personality Development | 2 | 3 | 50 | 50 | 100 | 3 |
| V | III | | Operations Research | 5 | 3 | 50 | 50 | 100 | 5 |
| | III | | Testing of Hypothesis | 5 | 3 | 50 | 50 | 100 | 4 |
| | III | | Applied Regression Analysis | 5 | 3 | 50 | 50 | 100 | 4 |
| | III | | Statistics using R language | 5 | 3 | 50 | 50 | 100 | 4 |
| | III | | Major Practical – III | 6 | 3 | 50 | 50 | 100 | 2 |
| | IV | | Total Quality Management | 4 | 3 | 50 | 50 | 100 | 3 |
| | IV | | Computer Training | - | - | - | - | - | 3 |
| VI | III | | Design of Experiments | 6 | 3 | 50 | 50 | 100 | 5 |
| | III | | Applied Statistics | 6 | 3 | 50 | 50 | 100 | 4 |
| | III | | Stochastic Processes | 6 | 3 | 50 | 50 | 100 | 4 |
| | III | | Programming in Python | 6 | 3 | 50 | 50 | 100 | 4 |
| | III | | Major Practical IV | 6 | 3 | 50 | 50 | 100 | 3 |
| | V | | Extension Activity | - | - | - | - | - | 1 |
| **Total Hours** | | | | **180** | | **Total Credit** | | | **140** |

## CURRICULUM OVERVIEW TABLE

| Curriculum Overview Table | | |
|---|---|---|
| **Part** | **Credits** | **Hours / Cycle** |
| I - Language | 3+3+3+3=**12** | 4+4+4+4=**16** |
| II - English | 3+3+3+3=**12** | 4+4+4+4=**16** |
| III – Core theory (mandatory) | 8+8+8+8+17+17=**66** | 8+8+8+8+20+24=**76** |
| III – Core Practical | 0+2+0+2+2+3=**9** | 2+2+2+2+6+6=**20** |
| III – Allied Theory | 4+4+4+4=**16** | 4+4+4+4=**16** |
| III – Allied Practical | 0+2+0+2=**4** | 2+2+2+2=**8** |
| IV – GC | 2+2=**4** | 4+4 =**8** |
| IV – GE | **3** | **4** |
| IV – Value Education | 1+1=**2** | 2+2=**4** |
| IV – ID | **3** | **4** |
| IV – EVS | **2** | **4** |
| IV – Computer Training | **3** | **-** |
| IV – Personlaity Development | **3** | 2+2 =**4** |
| V – Extension Activity | **1** | **-** |
| **Total** | **140** | **180** |

## B.Sc. Statistics -Syllabus Revision Details

| Course code | Course title | Type of Change | % of Change |
|---|---|---|---|
| **Semester-I** | | | |
| 231ST1M01 | **Major:** Descriptive Statistics | Revised | 10 |
| 231ST1M02 | **Major:** Mathematics for Statistics | Revised | 10 |
| 231ST2M03 | **Major:** Major Practical - I | Revised | 10 |
| 231ST1A01 | **Allied:** Demography | Revised & Title changed | 10 |
| 231ST2A02 | **Allied:** Allied Practical - I | New Course | 100 |
| 231ST1G01 | **General Course:** Introductory Statistics | Revised | 10 |
| **Semester-II** | | | |
| 231ST2M01 | **Major:**Matrix Algebra | Revised | 10 |
| 231ST2M02 | **Major:**Probability and Random Variables | Revised | 10 |
| 231ST2M03 | **Major:**Major Practical – I | Revised | 10 |
| 231ST2A01 | **Allied:** Numerical Analysis | New Course | 100 |
| 231ST2A02 | **Allied:** Allied Practical - I | New Course | 100 |
| 231ST1G01 | **General Course:** Introductory Statistics | Revised | 10 |
| **Semester-III** | | | |
| | **Major:**Real Analysis | Revised | 30 |
| | **Major:**Distribution Theory | Revised | 10 |
| | **Major:**Major Practical - II | Revised | 10 |
| | **Allied:**Programming in C | Revised | 10 |
| | **Allied:**Allied Practical – II | New Course | 100 |
| | **Inter-Disciplinary:** Actuarial Statistics | Revised | 30 |
| **Semester-IV** | | | |
| | **Major:**Theory of Estimation | Revised | 30 |
| | **Major:**Sampling Techniques | Revised | 10 |
| | **Major:**Major Practical - II | Revised | 10 |
| | **Allied:** Data Analysis using SPSS and SQL | Revised & Title changed | 50 |
| | **Allied:** Allied Practical – II | New Course | 100 |
| **Semester-V** | | | |
| | **Major:**Operations Research | Revised | 10 |
| | **Major:**Testing of Hypothesis | Revised | 10 |
| | **Major:**Applied Regression Analysis | Revised & Title changed | 10 |
| | **Major:**Statistics using R language | Revised | 10 |
| | **Major:**Major Practical – III | New Course | 100 |
| | **General Elective:**Total Quality Management | Revised | 50 |
| **Semester-VI** | | | |
| | **Major:**Design of Experiments | Revised | 10 |
| | **Major:**Applied Statistics | Revised | 10 |
| | **Major:**Stochastic Processes | Revised | 10 |
| | **Major:**Programming in Python | New Course | 100 |
| | **Major:**Major Practical IV | Revised | 30 |
| | | **Total percentage of Changes** | **33.24** |

# SEMESTER-I

# DESCRIPTIVE STATISTICS

| | | | |
|---|---|---|---|
| **Course Code** | 231ST1M01 | | |
| **Credits** | 4 | | |
| **Hours / Cycle** | 4 | | |
| **Category** | Part-III | Core | Theory |
| **Semester** | I | | |
| **Year of Implementation** | From the academic year 2023_2024 onwards | | |
| **Course Objectives** | 1. To nurture the basics in Statistical Analysis.<br>2. To visualize the numerals in to charts and graphs.<br>3. To acquire knowledge on the basic tools for data analysis. | | |

| CO | Course Outcome(s) | PSO Addressed | Bloom's Taxonomy Levels (K1 to K6) |
|---|---|---|---|
| On completing the course successfully, the student will be able to | | | |
| CO1 | Define the measurement scales and show the information in to numerals in the form of frequency distribution and graphical representation. | PSO1 | K1 |
| CO2 | Understand and illustrate the measures of central tendencies and dispersions. | PSO1 | K2 |
| CO3 | Apply the co-efficient of variation for comparing the variables and identify the nature of the frequency distribution applying the concept of skewness and kurtosis. | PSO2 | K3 |
| CO4 | Compare the variables using correlation analysis and study the relationship between the attributes. | PSO3 | K4 |
| CO5 | Design the regression equations and predicts the values of the variables. | PSO4 | K5,K6 |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Statistics: An Overview – Measurement scale – nominal, ordinal, interval and ratio – Data Sources – Frequency distribution (Uni-variate and Bi-variate) – Types of data and Forms of Frequency Distributions – Cumulative and Relative Frequencies- Graphical representation of statistical data: Bar charts, Pie diagram, Histogram, Ogives – Line diagram -Stem and Leaf-Box plot | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Measures of Central tendency: Arithmetic Mean – Weighted Arithmetic Mean - Median, Mode, Harmonic Mean, Geometric Mean – Quartiles, Deciles and Percentiles – Mathematical Properties. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Measures of dispersion and their Properties: Range, Quartile deviation, Mean deviation (about mean, median and mode) – Variance and standard deviation (Ungrouped Data - Grouped Data) – Coefficient of Variation - Moments, skewness and kurtosis – Comparison of Measures - Change of Scale for a Frequency Distribution. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Simple correlation and regression : Introduction – Scatter diagram – Karl Pearson's coefficient of correlation – Properties of correlation coefficients - Spearman's rank correlation – Simple regression – Properties of regression coefficients. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Association of Attributes – Order of classes and class frequencies – Relation between class frequencies – Consistency association – Comparison of observed and expected frequencies methods – Proportion method – Yule's coefficient of Association. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Gupta, S. P (2021) - 46th Edition, Statistical Methods, Sultan Chand and Sons, New Delhi
2. Gupta, S. C and Kapoor, V. K (2020)- 12th Edition, Fundamental of Mathematical Statistics, Sultan Chand and Sons

**References**

1. Goon A M, Gupta M K, Das Gupta B(2013) - Fundamentals of Statistics, (Vol-I), The World Press (Pvt) Ltd., Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Croxton, F.E. and Cowden, D.J. (1969) Applied General Statistics, Prentice Hall, New Delhi

**Suggested Reading**

1. Hogg, R.V., McKean, J.W. and Craig, A.T. (2013).Introduction to Mathematical Statistics, (Seventh Edition), Pearson Education Ltd.
2. Spiegel, M.R., Schiller, J. and Srinivasan, R.A. (2012).Probability and Statistics, Schaum's Outline Series (Fourth Edition), McGraw- Hill Publishing Company, New Delhi

**Web Resources**

1.https://cbseacademic.nic.in//web_material/Manuals/appliedmaths/chapter10_Descriptive_Statistics.pdf
2. https://online.stat.psu.edu/stat462/node/89
3.https://sscc.wisc.edu/sscc/pubs/RegressionDiagnostics.html

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 3 | - | - | - | - | - | - | 2 | - | - | - | - | K1 |
| CO2 | - | 3 | - | - | - | - | - | - | 2 | - | - | - | - | K2 |
| CO3 | - | - | - | - | 3 | - | - | - | - | 2 | - | - | - | K3 |
| CO4 | - | - | - | - | 3 | - | - | - | - | - | 3 | - | - | K4 |
| CO5 | - | - | - | - | 3 | - | - | - | - | - | - | 3 | - | K5,K6 |
| Wt. Avg. | - | 3 | - | - | 3 | - | - | - | 2 | 2 | 3 | 3 | - | |
| Overall Mapping of the Course | | | | | | | | | | | | PO -3 | | |
| | | | | | | | | | | | | PSO-2.5 | | |

# MATHEMATICS FOR STATISTICS

| | | | |
|---|---|---|---|
| **Course Code** | **231ST1M02** | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **4** | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **I** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To gain knowledge in basic concepts of differentiation and integration.**<br>**2. To enhance the ability of learners to apply the knowledge and skill acquired by them to solve specific theoretical and applied problems in mathematics.**<br>**3. It also encourages the students to develop a range of generic skill helpful in employment, internships in social activities.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Recall the basic concepts of differentiation and integration** | **PSO1** | **K1** |
| **CO2** | **Demonstrate differentiation and integration for various types of mathematical functions** | **PSO1**<br>**PSO2** | **K2** |
| **CO3** | **Apply the concept of differentiation and integration in Probabilty and distribution theory** | **PSO2**<br>**PSO4** | **K3** |
| **CO4** | **Compare the relationship between Gamma and Beta function, differential equations** | **PSO2**<br>**PSO4** | **K4** |
| **CO5** | **Bulid mathematical knowledge and skills for the better understanding of statistics as a mathematical science** | **PSO2**<br>**PSO4** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Successive Differentiation – Partial differentiation – Maxima and minima of functions of two variables. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Integration – simple problems - rational function- irrational function - integration by parts. | **14** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Definite integrals - simple problems –Properties of definite integrals – Reduction formula -Bernoulli's formula | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Beta and Gamma functions : Definitions-Recurrence formula of Gamma functions – properties of Beta functions– Relationship between Beta and Gamma functions. | **10** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Differential equations: Exact differential equations of first order - Differential equations of first order – Differential equations of second order with constant coefficients. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Narayanan, S and Manikavachagam Pillay, T. K (1998), Ancillary Mathematics, S. Viswanathan Publishers, Chennai.

**References**

1. Duraipandian, P. and UdayaBaskaran, S. (2014): Allied Mathematics, Vol. – I&II,S.Chand& Company Pvt. Ltd.
2. Sudha, S (1998), Calculus, Emerald Publishers, Chennai
3. Vittal, P.R ( 2012). Allied Mathematics, Margham Publications.

**Suggested Reading**

1. Shanti Narayan, Mittal, P. K. (2014), Differential Calculus, S. Chand.
2. Shanti Narayan, Mittal, P. K. (2014), Integral Calculus, S. Chand.

**Web Resources**

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

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 3 | - | - | - | - | - | - | 2 | - | - | - | - | K1 |
| CO2 | - | 3 | - | - | 2 | 2 | 2 | - | 2 | 3 | - | - | - | K2 |
| CO3 | - | 3 | 3 | - | 2 | 2 | 2 | - | - | 3 | - | 2 | - | K3 |
| CO4 | - | 3 | 3 | - | 2 | 2 | 2 | - | - | 3 | - | 2 | - | K4 |
| CO5 | - | 3 | 3 | - | 2 | 2 | 2 | - | - | 3 | - | 2 | - | K5,K6 |
| Wt. Avg. | - | 3 | 3 | - | 2 | 2 | 2 | - | 2 | 3 | - | 2 | - | |
| Overall Mapping of the Course | | | | | | | | | | | | PO 2.4 | | |
| | | | | | | | | | | | | PSO-2.3 | | |

# DEMOGRAPHY

| | | | |
|---|---|---|---|
| Course Code | 231ST1A01 | | |
| Credits | 4 | | |
| Hours / Cycle | 4 | | |
| Category | Part III | Allied | Theory |
| Semester | I | | |
| Year of Implementation | From the academic year 2023_2024 onwards | | |
| Course Objectives | 1.To have the knowledge about Vital Statistics.<br>2. To study about Demography.<br>3. Introduction to Growth Curves and their fitting. | | |

| CO | Course Outcome(s) | PSO Addressed | Bloom's Taxonomy Levels (K1 to K6) |
|---|---|---|---|
| On completing the course successfully, the student will be able to | | | |
| CO1 | Define Health Statistics, Vital Statistics, Fertility, Demography and Growth Curves. | PSO1<br>PSO5 | K1 |
| CO2 | Explain the different Measures of mortality, Life Tables and Measures of Fertility | PSO1<br>PSO2 | K2 |
| CO3 | Construct different types Growth Curves and fit them. | PSO2<br>PSO3<br>PSO4 | K3 |
| CO4 | Classify and Analyzedifferent tyesof Measures of mortality and Measures of Fertility. | PSO2<br>PSO3<br>PSO4 | K4 |
| CO5 | Discuss indetail about the Demography,Health Statistics and Vital Statistics. | PSO1<br>PSO2<br>PSO5 | K5,K6 |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Health Statistics: Introduction – Utilization of basic data - Sources of health statistics - Problems in the collection of sickness data - Measurements of sickness. Hospital statistics: Introduction – Terminology – Some Indices - International classification of diseases. Introduction to Sustainable Development Goals (SDGs) – Transition from Millennium Development Goals (MDGs) – What is 2030 Agenda? – 17 Sustainable Development Goals (SDGs) driving the global development agenda. Multi-level review processes and indicators - Ten principles for Global Monitoring Indicators – Key Indices – Multidimensional Poverty Index. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Vital Statistics: Introduction – Use of Vital Statistics - Methods of Obtaining Vital Statistics – Basic formulae for calculation of vital statistics. Measures of mortality rates: Crude Death Rate - Specific death rate – Causes of death rate - Infant mortality rate - Neonatal mortality rate - Foetal death rate - Maternal Mortality rate –- Early Child Development Index (ECDI) – GNI per capita (PPP, current US$ Atlas method) – Index on ICT maturity – Gini Coefficient – Human Mobility Governance Index – Global food loss index. Standardised Death rates: Direct and indirect standardization of death rates. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | . Measures of Fertility: Crude Birth Rate - General and specific fertility rates - General Marital Fertility Rate - Age specific fertility rate - Total fertility rate - Gross reproduction rate - Net reproduction rate. Life Tables: Introduction – Notations and Terminology – Expectation of Life – Stationary and Stable Populations – Central Mortality rate – Force of Mortality – Assumptions, Description and construction of life table - Uses of life tables. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Demography: Population growth - Age and sex composition - Dependency ratios – Demographic Transition - Population Estimation – Methods of Natural Increase Method – Arithmetic Progression Method – Geometric Progression Method- Comparison of the three methods. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | .Growth Curves and their fitting: Introduction – Least Square method - Linear growth curve - Modified exponential curve - Gompertz curve - Logistic curve | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Sundar Rao, P. S. S and Richard, J (1999), An Introduction to Bio-Statistics and Research Methods, Prentice Hall of India (IV Edition), PHI Publications, New Delhi.( Chapter 18, Chapter 19 & Chapter 21)
2. Gupta, S. C and Kapoor, V. K (2001), Fundamentals of Applied Statistics, Sultan Chand and sons, New Delhi. (Chapter 2: Section 2.4.3 & 2.4.4 and Chapter 9)
3. Baskar, D. Misra (2000), An Introduction to the Study of Population, South Asian Publishers Pvt. Ltd.

**References**

1. Indicators and a Monitoring Framework for the Sustainable Development Goals (2015). A report of the United Nations.
2. JH Lundquist, DL Anderton, D Yaukey (2014),Demography: The study of human population,Wave Land Press.
3. TB Gage, JM McCullough, CA Weitz,(1989),Demographic studies and human population biology,Oxford University Press.

**Suggested Reading**

1. Yaukey,David (1990)Demography : the study of human population,Waveland Press.
2. George Chandler Whipple(2017)Vital Statistics:An Introduction to the Science of Demography,Fb&cLimite

**Web Resources**

1. https://unstats.un.org/unsd/demographic/standmeth/principles/m19rev3en.pdf
2. https://score.tools.who.int/fileadmin/uploads/score/Documents/Count_births__deaths_and_causes_of_death/Strengthening_CRVS__resource_kit/CRVS%20strengthening%20resource%20kit.pdf
3. https://www.ctanujit.org/uploads/2/5/3/9/25393293/20_vital_statistics.pdf

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 2 | 2 | - | - | - | - | 2 | 3 | - | - | - | 2 | K1 |
| CO2 | - | 2 | - | - | 2 | 2 | 2 | - | 3 | 3 | - | - | - | K2 |
| CO3 | - | 2 | 3 | 2 | 3 | 3 | 3 | - | - | 3 | 2 | 3 | - | K3 |
| CO4 | - | 2 | 3 | 2 | 3 | 3 | 3 | - | - | 3 | 2 | 3 | - | K4 |
| CO5 | - | 2 | 2 | - | 2 | 2 | 2 | 2 | 3 | 3 | - | - | 3 | K5, K6 |
| Wt. Avg. | - | 2 | 2.5 | 2 | 2.5 | 2.5 | 2.5 | 2 | 3 | 3 | 2 | 3 | 3 | |
| Overall Mapping of the Course | | | | | | | | | | | | | PO- 2.2<br>PSO- 2.8 | |

# INTRODUCTORY STATISTICS

| | | | |
|---|---|---|---|
| **Course Code** | 231ST1G01 | | |
| **Credits** | 2 | | |
| **Hours / Cycle** | 4 | | |
| **Category** | Part-IV | General Course | Theory |
| **Semester** | I | | |
| **Year of Implementation** | From the academic year 2023_2024 onwards | | |
| **Course Objectives** | 1. To develop the basic concept and ability to deal with numerical and quantitative issues in business<br>2. To enable the use of statistical, graphical and algebraic techniques wherever relevant.<br>3. To have a proper understanding of Statisticalapplications. | | |

| CO | Course Outcome(s) | PSO Addressed | Bloom's Taxonomy Levels (K1 to K6) |
|---|---|---|---|
| On completing the course successfully, the student will be able to | | | |
| CO1 | Define various methods of collecting data and get familiar with some elementary methods of data viz. Measures of central tendency, dispersion, skewness and kurtosis, correlation and regression and to interpret them. | PSO1 | K1 |
| CO2 | Understand the concept of discrete and continuous frequency distribution and Pictorial Representation of data. | PSO1<br>PSO2 | K2 |
| CO3 | Construct the statistical analysis of descriptive statistics and inferential statistics | PSO3<br>PSO4 | K3 |
| CO4 | Discuss critically the uses and limitations of statistical analysis | PSO3<br>PSO4 | K4 |
| CO5 | Solve a range of problems using the techniques covered. Conduct basic statistical analysis of data. | PSO3<br>PSO4<br>PSO5 | K5,K6 |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Introduction: Definition of Statistical data, Statistical methods, Functions of Statistics-Applications of Statistics. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Collection of Data: Method of collecting primary and secondary data – census, sampling methods – Lottery method - Table of random numbers – Essentials of sampling. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Pictorial Representation of data: Bar diagrams – Pie diagrams – Histogram – Ogives. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Classification : Types of classification – Formulation of discrete and continuous frequency distribution - Measures of Location : Mean, Median, Mode, Quartiles - Measures of variation: Variance and Standard deviation. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Simple correlation and regression : Introduction, Scatter diagram, Karl Pearson's coefficient of correlation - rank correlation - simple regression - Attributes and association of attributes | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**


1. Everson, M., Gundlach, E., & Miller, J. (2013). Social media and the introductory statistics course. Computers in Human Behavior, 29(5), A69-A81.
2. Gun, A. M., Gupta, M. K., &Dasgupta, B. (2013). Fundamentals of statistics. World Press Private.
3. Gupta, S. C., & Kapoor, V. K. (2020). Fundamentals of mathematical statistics. Sultan Chand & Sons.


**References**


1. Morgan, G. A., Leech, N. L., Gloeckner, G. W., & Barrett, K. C. (2004). SPSS for introductory statistics: Use and interpretation. Psychology Press.
2. Illowsky, B., & Dean, S. (2018). Introductory statistics.
3. Minton, P. D. (1988). Introductory Statistics.
4. DeShea, L., &Toothaker, L. E. (2015). Introductory Statistics.


**Suggested Reading**


1. Mann, P. S. (2007). Introductory statistics. John Wiley & Sons.
2. Quenouille, M. H. (2014). Introductory statistics. Elsevier.
3. Rumsey, D. J. (2002). Statistical literacy as a goal for introductory statistics courses. Journal of statistics education, 10(3).

**Web Resources**

1. https://youtu.be/IngKIlvpg3s
2. https://youtu.be/74oUwKezFho
3. https://youtu.be/Ge9je05uYJ0
4. https://youtu.be/lBB4stn3exM
5. https://youtu.be/_0rEKoYExLw
6. https://youtu.be/Q6qU2i9qu28

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 2 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO2 | - | 2 | - | - | 2 | 2 | 2 | - | 2 | 2 | - | - | - | K2 |
| CO3 | - | - | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | - | K3 |
| CO4 | - | - | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | - | K4 |
| CO5 | - | | 2 | 2 | 2 | 2 | 2 | 2 | - | - | 2 | 2 | 2 | K5,K6 |
| Wt. Avg. | - | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.5 | 2 | 2 | 2 | 2 | - |
| Overall Mapping of the Course | | | | | | | | | | | | PO- 2 | | |
| | | | | | | | | | | | | PSO-2.1 | | |

# SEMESTER-II

# MATRIX ALGEBRA

| | | | |
|---|---|---|---|
| **Course Code** | 231ST2M01 | | |
| **Credits** | 4 | | |
| **Hours / Cycle** | 4 | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **II** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To study the basic operations of matrices<br>2. To learn methods for solving systems of linear equations using matrix method<br>3. To acquire competence in algebraic methods involving Eigen values and Eigen vectors and quadratic forms.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Label basic concepts of matrix algebra** | **PSO1** | **K1** |
| **CO2** | **Demonstrate types of matrix, types of linear equation** | **PSO2<br>PSO4** | **K2** |
| **CO3** | **Choose appropriate matrix for finding characteristic roots and vectors, quadratic forms** | **PSO2<br>PSO4** | **K3** |
| **CO4** | **Apply concepts of matrix, quadratic forms in real life problems** | **PSO2<br>PSO4<br>PSO5** | **K4** |
| **CO5** | **Recommend appropriate type of matrix to be used in vector space and quadratic forms.** | **PSO2<br>PSO4<br>PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Matrix Algebra : Definition – Types of Matrices - Rectangular – Square – Null - Identity – Diagonal – Scalar-Triangularmatrices-AlgebraofMatrices:Addition-Scalar multiplication-Multiplication of matrices - Properties of Matrix addition - Multiplication – Conjugate matrices – Transpose and Transjugate matrices – Trace of a matrix – Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Orthogonal, Unitary, Idempotent, Nilpotent matrices and their properties. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Adjoint and inverse : Adjoint matrices – Properties – Inverse of a matrix – Properties – Elementary transformations–Minor and cofactor of a matrix-Methods of finding inverse : Adjoint and elementary transformation methods-Matrix representation of a set of equations- Solutions of simultaneous equations using matrix inverse method. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Rank of a matrix : Definition– Normal form – Use of rank concepts – Linear homogeneous and non homogeneous equations–Consistency of equations – Solutions for linear equations. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Characteristic Roots and Vectors: Definition – Characteristic roots of Null, Identity, Scalar, Diagonal, Upper triangular, Lower triangular matrices – Characteristic roots of adjoint and inverse of a matrix – Properties of characteristic roots – Characteristic vectors and their Properties. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Quadraticforms : Definition – Reduction of QFs to canonical forms – Congruent and Lagrange reductions– Index and Signature of QFs.<br>Vector spaces: Definition- Examples- Simple algebraic properties of a vector space – Basis and Dimensions-Linear dependenceof vectors. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Gupta,S.C(2018), AnIntroductiontoMatrices,SultanChandandSons,New Delhi.

**References**

1. Vasishtha.A.R (1972) : Matrices, KrishnaprakashanMandir, Meerut.
2. Vatsa,B. S and Vatsa, S (2014),Theory of Matrices, New Age International Publishers, Third edition, New Delhi, India.
3. ShanthiNaryanan (2012), A TextBook of Matrices, SultanChand and Sons, Ninth edition,Delhi.

**Suggested Reading**

1. Hohn, F. E, (2012), Elementary Matrix Algebra, Statistical Methods, 3rd Edition, DoverPublications.
2. Aggarwal, R.S,( 1987), A text book on Matrices, 4th Edition, Sultan Chand & Sons, NewDelhi.
3. Richard Bronson, (2005), Theory and Problems of Matrix Operations, Tata McGrawHill.

**Web Resources**

1. https://www.math.pku.edu.cn/teachers/anjp/textbook.pdf
2. https://samples.jbpub.com/9781556229114/chapter7.pdf
3. http://www.math.nagoya-u.ac.jp/~richard/teaching/f2014/Lin_alg_Lang.pdf

***Please avoid numerical problems involving calculators as they are done in Major Practical***

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO 1 | - | 3 | - | - | - | - | - | - | 2 | - | - | - | - | K1 |
| CO 2 | - | 3 | 2 | - | 2 | 2 | 2 | - | - | 3 | - | 2 | - | K2 |
| CO 3 | - | 3 | 2 | - | 2 | 2 | 2 | - | - | 3 | - | 2 | - | K3 |
| CO 4 | - | 3 | 2 | - | 2 | 2 | 2 | 2 | - | 3 | - | 2 | 2 | K4 |
| CO 5 | - | 3 | 2 | - | 2 | 2 | 2 | 2 | - | 3 | - | 2 | 2 | K5,K6 |
| Wt. Avg. | - | 3 | 2 | - | 2 | 2 | 2 | 2 | 2 | 3 | - | 2 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO -2.17 | | |
| | | | | | | | | | | | | PSO -2.25 | | |

# PROBABILITY AND RANDOM VARIABLES

| | | | |
|---|---|---|---|
| **Course Code** | **231ST2M02** | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **4** | | |
| **Category** | **Part III** | **Core** | **Theory** |
| **Semester** | **II** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To introduce probability's fundamental ideas.**<br>**2. To develop the logical foundation and analytical thinking of probability theory**<br>**3. To demonstrate the abilities required to resolve real-world probability and random variable problems.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Recall the essential ideas of probability of events, establish fundamental theorems, and compute probabilities using the rules of probability.** | **PSO1** | **K1** |
| **CO2** | **Recognise, use, and prove the theorem based on conditional probability. To apply these ideas to tackle practical issues.** | **PSO1**<br>**PSO2** | **K2** |
| **CO3** | **Utilise the idea of random variables and their different kinds. Identifying the traits of the probability function that correspond to these kinds.** | **PSO2**<br>**PSO3** | **K3** |
| **CO4** | **Investigate the idea of mathematical expectation, demonstrating its attributes, and establishing the connection between unconditional and conditional expectations.** | **PSO2**<br>**PSO3**<br>**PSO4**<br>**PSO5** | **K4** |
| **CO5** | **Use various generating functions, calculate probability distribution moments. Describe Cauchy-Schwartz, Chebychev's inequality, and their uses in determining actual probabilities.** | **PSO2**<br>**PSO3**<br>**PSO4**<br>**PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Basic concepts of Probability - Trial, Events, Random Experiments, Sample space- Classical and empirical approach to probability and their limitations –Types of events: Exhaustive, Mutually exclusive, Equally likely and Independent events - Axiomatic approach to probability - Basic theorems on probability using axiomatic approach - Addition theorem on probability for ***n*-**events, Boole's inequality. | **10** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Conditional probability – Multiplication theorem on probability for n-events. Independence of events –Pair-wise independence and mutual independence – Bayes' theorem and Simple applications. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Random variables: Discrete and continuous random variables - Probability mass function and probability density function- Bi-variate random variables: Joint probability density function -Marginal and conditional density functions - Stochastic independence. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Mathematical expectation - Variance, Covariance and their properties - Marginal and -conditional expectations - Conditional variances Correlation - Relationship between unconditional and conditional expectations. | **13** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Moment generating function and its properties - Cumulant generating function- Characteristicfunction - Probability generating functions (Concepts only) - Cauchy-Schwartz Inequality and its applications - Chebyshev's Inequality and its applications. | **13** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks(1-5 books)**

1. Gupta, S.C and Kapoor, V. K (2002), Fundamentals of Mathematical Statistics, SultanChand and Sons, New Delhi.
2. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference,Seventh Ed, PearsonEducation, New Delhi.
3. Lipshutz, S, Lipson, M & Jain, K. (2017): Schaum's Outlines Series on Probability

**References**

1. Hogg, R. V and Craig, A. T (2006), Introduction to Mathematical Statistics, Pearson Education, New Delhi.
2. Saxena, H. C (1968), Statistical Inference, Sultan Chand and Sons, New Delhi.
3. Rohatgi, V.K. and Saleh, A.K.Md.E. (2002): An introduction to probability and Statistics, John Wiley andSons.
4. Sanjay Arora &Bansilal (1989): New Mathematical statistics, Meerat Publications, New Delhi

**Suggested Reading**

1. Meyer, P.L.(1970) : Introduction to Probability and Statistical Applications, 2nd edition, Addison-Wesley.
2. Irwin Miller and Marylees Miller (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia

**Web Resources (3-5)**

1. https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library
2. https://www.stat.pitt.edu/stoffer/tsa4/intro_prob.pdf
3. https://www.econometrics-with-r.org/2-1-random-variables-and-probability-distributions.html
4. https://www.mathsisfun.com/data/random-variables.html

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 2 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO2 | - | 2 | - | - | 3 | 2 | 2 | - | 3 | 1 | - | - | - | K2 |
| CO3 | - | - | - | 2 | 3 | - | 2 | - | - | 3 | 2 | - | - | K3 |
| CO4 | - | - | 2 | - | - | 2 | 2 | - | - | 2 | 3 | 3 | 3 | K4 |
| CO5 | - | - | 2 | - | - | - | - | 2 | - | 1 | 2 | 3 | 3 | K5,K6 |
| Wt. Avg. | - | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1.75 | 2.3 | 3 | 3 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO – 2.14 | | |
| | | | | | | | | | | | | PSO-2.61 | | |

# MAJOR PRACTICAL – I

| | | | |
|---|---|---|---|
| **Course Code** | **231ST2M03** | | |
| **Credits** | **2** | | |
| **Hours / Cycle** | **2** | | |
| **Category** | **Part III** | **Core** | **Practical** |
| **Semester** | **I & II** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To present the data in a consolidated form**<br>**2. To describe the univariate and Bivariate characteristics of the data set.**<br>**3. To perform matrix operations and arriving solutions to linear equations.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Remember how to represent data in the form of frequency distribution** | **PSO1<br>PSO2** | **K1** |
| **CO2** | **Understand the graphical representation of data** | **PSO1<br>PSO2** | **K2** |
| **CO3** | **Apply different types of descriptive measures for the given data** | **PSO2<br>PSO4** | **K3** |
| **CO4** | **Distinguish and to perform simple analysis for qualitative and quantitative characteristics.** | **PSO2<br>PSO4** | **K4** |
| **CO5** | **Evaluate the operations on matrices and to find characteristic roots and vectors for the given matrix** | **PSO1<br>PSO2<br>PSO4** | **K5,K6** |

## EXCERICES

1. Formulation of Univariate frequency distribution.
2. Formulation of Bivariate frequency distribution
3. Calculation of Mean, Median, Mode (Raw and Grouped data)
4. Calculation of Harmonic mean , Geometric mean (Raw and Grouped data)
5. Graphical representation of Median and Mode
6. Quartiles, Deciles and Percentiles
7. Calculation of range and quartile deviation
8. Mean deviation about mean, median
9. Standard deviation, variance and coefficient of variation
10. Moments, Skewness and Kurtosis
11. KarlPearson's coefficient of correlation (Raw data)
12. KarlPearson's coefficient of correlation (Grouped data)
13. Spearman's Rank correlation
14. Regression equations
15. Association of attributes
16. Multiplication of matrices
17. Inverse of a matrix of order upto [4x4]
18. Rank of a matrix by elementary operations.
19. Solution of linear equations
20. Characteristic roots and vectors

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO 1 | - | 2 | - | -- | 2 | 2 | 2 | - | 2 | 2 | - | - | - | K1 |
| CO 2 | - | 2 | - | - | - | 2 | 2 | - | 2 | 2 | - | - | - | K2 |
| CO 3 | - | 2 | 2 | - | 2 | 2 | 2 | - | - | 2 | - | 2 | - | K3 |
| CO 4 | - | 2 | 2 | - | 2 | 2 | 2 | - | - | 2 | - | 2 | - | K4 |
| CO 5 | - | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 2 | - | 2 | - | K5,K6 |
| Wt. Avg. | - | 2 | 2 | - | 2 | 2 | 2 | - | 2 | 2 | - | 2 | - | |
| Overall Mapping of the Course | | | | | | | | | | | | PO-2 / PSO-2 | | |

# NUMERICAL ANALYSIS

| | | | |
|---|---|---|---|
| **Course Code** | **231ST2A01** | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **4** | | |
| **Category** | **Part-III** | **Allied** | **Theory** |
| **Semester** | **II** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards.** | | |
| **Course Objectives** | **1. To understand the concept of interpolation and extrapolation.<br>2. To find solutions for linear and transcendental equations using numerical methods.<br>3. To comprehend the concept of numerical differentiation and integration.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Recognise the role of numerical mathematics in interpolation, extrapolation, solving of equations, differentiation and integration.** | **PSO1<br>PSO2<br>PSO4<br>PSO5** | **K1** |
| **CO2** | **Relate to the applications of numerical methods.** | **PSO1<br>PSO2<br>PSO4<br>PSO5** | **K2** |
| **CO3** | **Select an appropriate numerical method to solve the problem.** | **PSO1<br>PSO2<br>PSO4<br>PSO5** | **K3** |
| **CO4** | **Distinguish between interpolation and extrapolation& equal and unequal intervals.** | **PSO1<br>PSO2<br>PSO4<br>PSO5** | **K4** |
| **CO5** | **Perceive the differences in forward, backward and central difference formulae.** | **PSO1<br>PSO2<br>PSO4<br>PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Finite differences – forward and backward difference operators – Interpolation with Equal Intervals – Newton's forward and backward difference formulae | **13** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Interpolation with unequal intervals – Divided Differences – Newton's Formula for Unequal Intervals – Lagrange's Interpolation formula. | **10** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Central Difference Interpolation formulae – Gauss Forward and Backward Interpolation formulae – Stirling's, Bessel's and Laplace-Everett Interpolation Formulae. | **14** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Inverse interpolation – Lagrange's formula – Solution to transcendental equations – Bisection and Newton-Raphson Method. | **10** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Numeriacal Differentiation – Numerical Integration – Trapezoidal Rule – Simpson one third and three eighth rule. | **13** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Saxena, H. C. (1988). *Finite Differences and Numerical Analysis*. S. Chand Publishing.

**References**

1. Hildebrand, F. B. (1987). *Introduction to numerical analysis*. Courier Corporation.
2. Sastry, S. S. (2012). *Introductory methods of numerical analysis*. PHI Learning Pvt. Ltd.
3. Mollah, S. A. (2012). *Numerical Analysis and Computational Procedures*. Publisher Arunabha Sen Books and Allied (P) Ltd.

**Suggested Reading**

1. Gupta, P. P., Gupta, S., & Malik, G. S. (1980). *Calculus of finite difference & numerical analysis*. Krishna Prakashan Media.
2. Kandasamy, P., &Gunavathi, K. (2008). *Numerical Methods Vol-IV (Tamil Nadu)*. S. Chand Publishing.

**Web Resources**

1. https://www.math.hkust.edu.hk/~machas/numerical-methods.pdf
2. https://www.math.iitb.ac.in/~baskar/book.pdf
3. https://blasingame.engr.tamu.edu/z_zCourse_Archive/P620_14C/P620_14C_zReference/PDF_Txt_Hnbk_Num_Meth.pdf

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Course Outcomes** | **Programme Outcomes** | | | | | | | | **Programme Specific Outcomes** | | | | | **Cognitive Level** |
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PSO1** | **PSO2** | **PSO3** | **PSO4** | **PSO5** | |
| **CO 1** | - | 3 | 2 | - | 2 | 2 | 2 | 2 | 3 | 1 | - | 2 | 3 | **K1** |
| **CO 2** | - | 3 | 2 | - | 2 | 2 | 2 | 2 | 3 | 1 | - | 2 | 3 | **K2** |
| **CO 3** | - | 3 | 2 | - | 2 | 2 | 2 | 2 | 3 | 1 | - | 2 | 3 | **K3** |
| **CO 4** | - | 3 | 2 | - | 2 | 2 | 2 | 2 | 3 | 1 | - | 2 | 3 | **K4** |
| **CO 5** | - | 3 | 2 | - | 2 | 2 | 2 | 2 | 3 | 1 | - | 2 | 3 | **K5,K6** |
| **Wt. Avg.** | **-** | **3** | **2** | **-** | **2** | **2** | **2** | **2** | **3** | **1** | **-** | **2** | **3** | |
| **Overall Mapping of the Course** | | | | | | | | | | | | **PO – 2.17** | | |
| | | | | | | | | | | | | **PSO –2.25** | | |

# ALLIED PRACTICAL – I

| | | | |
|---|---|---|---|
| **Course Code** | 231ST2A02 | | |
| **Credits** | 2 | | |
| **Hours / Cycle** | 2 | | |
| **Category** | Part-III | Allied | Practical |
| **Semester** | I &II | | |
| **Year of Implementation** | From the academic year 2023_2024 onwards | | |
| **Course Objectives** | 1. To understand the problem solving techniques used in Demography and Numerical analysis<br>2. To have practical knowledge in solving problems in Demography and Numerical Analysis using MS-EXCEL<br>3. To acquire knowledge about the applications of Demography . | | |

| CO | Course Outcome(s) | PSO Addressed | Bloom's Taxonomy Levels(K1 to K6) |
|---|---|---|---|
| On completing the course successfully, the student will be able to | | | |
| CO1 | Recall the basic formulas used in Demography and Numerical Analysis. | PSO1<br>PSO3 | K1 |
| CO2 | Relate the formulas to the applications in Demography and Numerical Analysis in MS-EXCEL | PSO2<br>PSO3 | K2 |
| CO3 | Select an appropriate technique to solve Demography and Numerical Analysis problem taken for study | PSO3<br>PSO4 | K3 |
| CO4 | Analyze the problem using the selected technique using MS –EXCEL | PSO3<br>PSO4 | K4 |
| CO5 | Interpret the findings of the end result for the problem taken for study | PSO3<br>PSO4<br>PSO5 | K5,K6 |

## EXERCISES

### SEMESTER - I

**Demography**

1. Life tables.
2. Life tables
3. Fitting of Growth Curves : Linear growth curve
4. Fitting of Growth Curves :Exponential growth curve.
5. Fitting of Growth Curves :Exponential growth curve.
6. Fitting of Growth Curves : Modified exponential growth curve
7. Fitting of Growth Curves :Gompertz curve
8. Fitting of Growth Curves :Gompertz curve
9. Fitting of Growth Curves : Logistic curve
10. Fitting of Growth Curves : Logistic curve

### SEMESTER - II

**Numerical Analysis**

1. Newton's Forward Interpolation
2. Newton's Backward Interpolation
3. Gauss Forward Interpolation
4. Gauss Backward Interpolation
5. Lagrange's Interpolation
6. Lagrange's Inverse Interpolation
7. Newton Raphson Method
8. Stirling's Interpolation
9. Bessel's Interpolation
10. Laplace-Everett Interpolation
11. Numerical Differentiation
12. Trapezoidal Rule
12. Simpson one third Rule
13. Simpson three eighth Rule

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 1 | - | 2 | 3 | - | 2 | - | 2 | - | 2 | - | - | K1 |
| CO2 | - | 1 | - | 2 | 3 | 2 | 2 | - | - | 2 | 2 | - | - | K2 |
| CO3 | - | - | 2 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | - | K3 |
| CO4 | - | - | 2 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | | K4 |
| CO5 | - | - | 2 | 2 | 3 | 2 | 2 | 2 | - | - | 2 | 2 | 2 | K5, K6 |
| Wt. Avg. | - | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO-2 | | |
| | | | | | | | | | | | | PSO-2 | | |

# INTRODUCTORY STATISTICS

| | | | |
|---|---|---|---|
| **Course Code** | 231ST1G01 | | |
| **Credits** | 2 | | |
| **Hours / Cycle** | 4 | | |
| **Category** | Part-IV | General Course | Theory |
| **Semester** | II | | |
| **Year of Implementation** | From the academic year 2023_2024 onwards | | |
| **Course Objectives** | 1. To develop the basic concept and ability to deal with numerical and quantitative issues in business<br>2. To enable the use of statistical, graphical and algebraic techniques wherever relevant.<br>3. To have a proper understanding of Statisticalapplications. | | |

| CO | Course Outcome(s) | PSO Addressed | Bloom's Taxonomy Levels (K1 to K6) |
|---|---|---|---|
| On completing the course successfully, the student will be able to | | | |
| CO1 | Define various methods of collecting Idata and get familiar with some elementary methods of data viz. Measures of central tendency, dispersion, skewness and kurtosis, correlation and regression and to interpret them. | PSO1 | K1 |
| CO2 | Understand the concept of discrete and continuous frequency distribution and Pictorial Representation of data. | PSO1<br>PSO2 | K2 |
| CO3 | Construct the statistical analysis of descriptive statistics and inferential statistics | PSO3<br>PSO4 | K3 |
| CO4 | Discuss critically the uses and limitations of statistical analysis | PSO3<br>PSO4 | K4 |
| CO5 | Solve a range of problems using the techniques covered. Conduct basic statistical analysis of data. | PSO3<br>PSO4<br>PSO5 | K5,K6 |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Introduction: Definition of Statistical data, Statistical methods, Functions of Statistics-Applications of Statistics. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Collection of Data: Method of collecting primary and secondary data – census, sampling methods – Lottery method - Table of random numbers – Essentials of sampling. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Pictorial Representation of data: Bar diagrams – Pie diagrams – Histogram – Ogives. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Classification : Types of classification – Formulation of discrete and continuous frequency distribution - Measures of Location : Mean, Median, Mode, Quartiles - Measures of variation: Variance and Standard deviation. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Simple correlation and regression : Introduction, Scatter diagram, Karl Pearson's coefficient of correlation - rank correlation - simple regression - Attributes and association of attributes | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**


4. Everson, M., Gundlach, E., & Miller, J. (2013). Social media and the introductory statistics course. Computers in Human Behavior, 29(5), A69-A81.
5. Gun, A. M., Gupta, M. K., &Dasgupta, B. (2013). Fundamentals of statistics. World Press Private.
6. Gupta, S. C., & Kapoor, V. K. (2020). Fundamentals of mathematical statistics. Sultan Chand & Sons.


**References**


5. Morgan, G. A., Leech, N. L., Gloeckner, G. W., & Barrett, K. C. (2004). SPSS for introductory statistics: Use and interpretation. Psychology Press.
6. Illowsky, B., & Dean, S. (2018). Introductory statistics.
7. Minton, P. D. (1988). Introductory Statistics.
8. DeShea, L., &Toothaker, L. E. (2015). Introductory Statistics.


**Suggested Reading**


4. Mann, P. S. (2007). Introductory statistics. John Wiley & Sons.
5. Quenouille, M. H. (2014). Introductory statistics. Elsevier.
6. Rumsey, D. J. (2002). Statistical literacy as a goal for introductory statistics courses. Journal of statistics education, 10(3).

**Web Resources**

7. https://youtu.be/IngKIlvpg3s
8. https://youtu.be/74oUwKezFho
9. https://youtu.be/Ge9je05uYJ0
10. https://youtu.be/lBB4stn3exM
11. https://youtu.be/_0rEKoYExLw
12. https://youtu.be/Q6qU2i9qu28

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 2 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO2 | - | 2 | - | - | 2 | 2 | 2 | - | 2 | 2 | - | - | - | K2 |
| CO3 | - | - | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | - | K3 |
| CO4 | - | - | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | - | K4 |
| CO5 | - | | 2 | 2 | 2 | 2 | 2 | 2 | - | - | 2 | 2 | 2 | K5,K6 |
| Wt. Avg. | - | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.5 | 2 | 2 | 2 | 2 | - |
| Overall Mapping of the Course | | | | | | | | | | | | PO- 2 | | |
| | | | | | | | | | | | | PSO-2.1 | | |

# SEMESTER-III

# REAL ANALYSIS

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **4** | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **III** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To study the fundamentals in a systematic and rigorous manner in the context of real valued functions of a real variable through various examples.<br>2. To construct and analyze the mathematical proofs in real valued functions.<br>3. To understand and apply the concepts of derivatives and integrals** | | |
| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Study the basic elements of sets and real valued functions with examples** | **PSO1** | **K1** |
| **CO2** | **Understand the concept of real valued functions, limit of a sequence, Cauchy sequence, derivatives and integrals** | **PSO1<br>PSO2** | **K2** |
| **CO3** | **Apply the convergence and divergences in series, non-negative numbers and non increasing sequences** | **PSO2<br>PSO3** | **K3** |
| **CO4** | **Analyze the properties and mathematical proofs of Riemann Integral, derivatives, Rolle's theorem, fundamental theorems of calculus, Lagrange's formula and Taylor's formulas** | **PSO4** | **K4** |
| **CO5** | **Evaluate the Mathematical Proofs ofRiemann Integral, Derivatives, Rolle's theorem, fundamental theorems of calculus, Lagrange's formula and Taylor's formulas with simple problems** | **PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Sets and Elements _ Operations on Sets – Functions – Real valued functions – Equivalence – Countability – Real Numbers – Least upper bounds | **10** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Definition of a Sequence and Subsequence – Limit of a Sequence – Convergence Sequences – Divergent Sequences – Bounded Sequences – Monotone Sequence – Operations on Convergent Sequence – Operations on Divergent Sequences – Limit Superior and Limit Inferior – Cauchy Sequences. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Convergence and Divergences – Series with Non-negative numbers – Alternating Series– Conditional Convergence and Absolute Convergence – Tests for Absolute Convergence – Series whose terms forma non-increasing Sequence. | **13** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Set of Measure Zero – Definition – Properties of Riemann Integral (without Proof) – Simple Problems – Derivatives – Algebra of Derivatives (without Proof) - Rolle's Theorem – Mean Value Theorem – Generalised Law of Mean – Simple Problems | **13** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Fundamental Theorem of Calculus –Second Fundamental Theorem of Calculus – Taylor's Theorem –Taylor's formula with Lagrange's form of the Remainder – Taylor's formula with Integral form of Reminder – Taylor's Formula with Cauchy form of the Reminder – simple problems | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**


1. Goldberg. R. Richard (1970): Methods of Real Analysis, Oxford and IBH Publishing CoPrivate Ltd., New Delhi.
2. Apostol, T. M. (1998). Introduction to analytic number theory. Springer Science & Business Media


**References**


1. S.C. Malik and Savita Arora (2017): Mathematical Analysis, New Age International Publications, New Delhi.
2. S. G. Venkatachalapathy (2009): Real Analysis, Margham Publications, Chennai.
3. H. L. Royden (1988), Real Analysis (Third Edition), Prentice – Hall of India PrivateLtd., New Delhi.


**Suggested Reading**


1. Walter Rudin (1976), Principles of Mathematical Analysis, Third Edition, McGraw Hill.
2. Davidson, K. R., &Donsig, A. P. (2009). Real analysis and applications: theory in practice. Springer Science & Business Media.
3. Chandrasekaran Rao and K.S. Narayanan (2008), S. Real Analysis (Vol.II), S. Viswanathan Pvt. Ltd., Chennai.

**Web Resources**

1. https://www.youtube.com/watch?v=KICfqqtod0&list=PLTYWkBB_Zi67KTmbeDxxBPxcEeqPfPC6f
2. https://www.youtube.com/watch?v=Rhc_kMwz0jY&list=PLTYWkBB_Zi67KTmbeDxxBPxcEeqPfPC6f&index=10
3. https://www.youtube.com/watch?v=0M8CkXmZtt4&list=PLTYWkBB_Zi67KTmbeDxxBPxcEeqPfPC6f&index=18
4. https://www.youtube.com/watch?v=c7JKhBarTUg&list=PLTYWkBB_Zi67KTmbeDxxBPxcEeqPfPC6f&index=25
5. https://www.youtube.com/watch?v=L7cFTokjXg&list=PLTYWkBB_Zi67KTmbeDxxBPxcEeqPfPC6f&index=26
6. https://www.math.lsu.edu/~sengupta/4031f06/IntroRe alAnalysNot es.pdf

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 3 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO2 | - | 3 | - | - | 2 | 2 | 3 | - | 3 | 3 | - | - | - | K2 |
| CO3 | - | - | - | 2 | 2 | - | 3 | - | - | 3 | 1 | - | - | K3 |
| CO4 | - | - | 3 | - | - | 3 | 3 | - | - | - | - | 3 | - | K4 |
| CO5 | - | - | 3 | - | - | - | - | 3 | - | - | - | - | 3 | K5, K6 |
| Wt. Avg. | - | 3 | 3 | 2 | 2 | 2.5 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO- 2.64 | | |
| | | | | | | | | | | | | PSO- 2.6 | | |

# DISTRIBUTION THEORY

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | 4 | | |
| **Hours / Cycle** | 4 | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **III** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To understand the conceps of distribution functions and to study avout the transformation of random variables.<br>2. To gain knowledge of important discrete and continuous distributions<br>3.To explore the limiting form of certain distributions** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Define probability distribution functions, basic discrete and continuous distributions and limit theorems** | **PSO1** | **K1** |
| **CO2** | **Discuss Discrete distributions like Binomial,Trinomial, Multinomial, Poisson, Negative Binomial and Geometric distributions and their Moments,Momentgeneratingfunction, Characteristic function and Cumulants.** | **PSO1<br>PSO2<br>PSO3** | **K2** |
| **CO3** | **Construct continuous distributions like Normal, Uniform, Exponential, Gamma and Beta distributions andsome Sampling distributions like Chi-square, Student's t and F distributions** | **PSO1<br>PSO2<br>PSO3** | **K3** |
| **CO4** | **Outline the relationship between the distribution functions and compare and study its properties** | **PSO3<br>PSO4<br>PSO5** | **K4** |
| **CO5** | **Explain central limit theorem . Develop the limiting case of certain distributions** | **PSO3<br>PSO4<br>PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Probability distribution function and its Properties-Points of infinite discontinuity of probability distribution functions-Derivations of probability density functions of transformations of one-dimensional random variables - Derivations of probability densityfunctions only with respect to sum, difference, product and quotient of two-dimensionalrandomvariables. | **10** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Discretedistributions:Binomial,Trinomial andMultinomialdistributionsandtheirproperties - Poisson, Negative Binomial and Geometric distributions and their Moments,Momentgeneratingfunction, Characteristic function,Cumulants. | **14** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Continuous distributions : Normal, Uniform, Exponential, Gamma and Beta distributions andtheirproperties. | **14** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Sampling distributions :Chi-square, Student's t and F distributions - Derivation of theirdensityfunctions and their properties, Comparisonof t, FandChi-squaredistributions | **14** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Weak law of large numbers- Central Limit Theorem (statement only)<br>Limiting distributions : Poisson distributionas a limiting case of Binomial - Poisson distribution as a limiting case of Negative Binomialdistribution - Convergence of Binomial, Poisson, Gamma and Chi-square distribution toNormal distribution using Moment generating function, Limiting form oft distribution –ConvergenceofFdistribution to Chi-squaredistribution. | **8** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Gupta, S.C and Kapoor, V.K. (2002): Fundamentals of Mathematical Statistics, Sultan Chand & Sons Pvt. Ltd., New Delhi.
2. Hogg, R.V., McKean, J. W. and Craig, A.T. (2006): Introduction to Mathematical Statistics, Sixth Edition, Pearson education, India.
3. Gupta, S.P. (2012) : Statistical Methods, Sultan Chand & Sons

**References**

1. Rohatgi, V.K. and Saleh, A.K. Md.E. (2002): An introduction to probability and Statistics, John Wiley and Sons.
2. Meyer, P.L.(1970) : Introduction to Probability and Statistical Applications, 2nd edition, AddisonWesley.
3. Hogg R.V. and Tanis, E. (1989) : Probability and Statistical Inference, Macmillian Publishing House, **,** New York

**Suggested Reading**

1. Dwass, M. (1970): Probability Theory and applications, Benjamin, New York
2. Feller, W., An introduction to Probability Thepry and its Applications, 2 Vol. Wiley, , New York

**Web Resources**

1. https://www.statisticshowto.com/discrete-probability-distribution/
2. https://corporatefinanceinstitute.com/resources/knowledge/other/discrete-distribution/
3. https://saylordotorg.github.io/text_introductory-statistics/s08-02-probability-distributions-for- .html
4. https://sites.nicholas.duke.edu/statsreview/continuous-probability-distributions/
5. https://www.statisticshowto.com/continuous-probability-distribution/

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 2 | - | - | - | - | - | - | 2 | - | - | - | - | K1 |
| CO2 | - | 2 | - | - | 2 | 2 | 2 | - | 2 | 2 | 2 | - | - | K2 |
| CO3 | - | - | - | 2 | 2 | - | 2 | - | 2 | 2 | 2 | - | - | K3 |
| CO4 | - | - | 2 | - | - | 2 | 2 | - | - | - | 2 | 2 | 2 | K4 |
| CO5 | - | - | 2 | - | - | - | - | 2 | - | - | 2 | 2 | 2 | K5,K6 |
| Wt. Avg. | - | 2 | 2 | - | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO -2 | | |
| | | | | | | | | | | | | PSO - 2 | | |

# PROGRAMMING IN C

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | 4 | | |
| **Hours / Cycle** | 4 | | |
| **Category** | **Part-III** | **Allied** | **Theory** |
| **Semester** | **III** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1.To familiarize with basic principles of programming.<br>2. To acquaint the students with good program design through structured programming paradigm.<br>3.To create own C programs for statistical analysis.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Define C programming features. Advantages and Disadvantages** | **PSO1<br>PSO2<br>PSO3** | **K1** |
| **CO2** | **Discuss C language statements that control the flow of a program's execution. To understand how code is repetitively executed.** | **PSO1<br>PSO2<br>PSO3** | **K2** |
| **CO3** | **Use and implement data structures like arrays and structures to obtain solutions.** | **PSO2<br>PSO3** | **K3** |
| **CO4** | **Compare structure within a 'c' program and will see how structures are defined, and how their individual members are accessed.** | **PSO3<br>PSO4** | **K4** |
| **CO5** | **Develop simple statistical programs.** | **PSO3<br>PSO4<br>PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Basic structure of C programs - constants - variables - data types - symbolic constants – Operators -Arithmetic Expressions – Type conversions - Input/output operations. | **10** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Decision making and branching: if -nested if - else if - switch statement - :? Operator- Unconditionalbranching: goto statement.Decision making and looping: for-nested for- while and do-while loops - continue and breakStatements. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Arrays - declaration and initialization of one and two-dimensional arrays – User-defined functions: function declaration and initialization- argument types – arrays and functions– introductory concept ofrecursion - scope of variable - storage classes - external, static, automatic and register types | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Structures: declaration and initialization - Arrays of structures – Unions - Pointers: Declaration andinitialization- - pointers and arrays - pointers as function arguments– Pointers and structures. | **10** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Simple Programs: Matrix Multiplication, Transpose and Inverse – Descriptive Statistics: Mean (Discreteand Continuous) – Standard Deviation (Discrete and Continuous) – Correlation coefficient – Fitting aStraight Line – Regression coefficient. | **16** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Balagurusamy, E (2007), Programming in Ansi C, 5 thedition, Tata McGraw-Hill, New Delhi.
2. SujathaSinha and SubhabrataDinda (2013), Numerical and Statistical Methods with Programming in C, Second Edition, Scitech Publications, Chennai.

**References**

1. Kernighan and Ritchie (1986), The C Programming Language, Prentice Hall of India, New Delhi.
2. Gottfried, B. S (1992), Programming with C, Schaum's outline series, Singapore.
3. YashavantKanetkar (2021), Let us C, BPB Publication-18 th edition.

**Suggested Reading**

1. https://cstutorialpoint.com/c-language-notes/
2. https://www.vssut.ac.in/lecture_notes/lecture1424354156.pdf

**Web Resources**

1. https://www.eskimo.com/~scs/cclass/notes/top.html
2. https://www.educba.com/c-programming-matrix-multiplication/
3. https://www.programiz.com/c-programming/examples/matrix-transpose
4. https://www.sanfoundry.com/c-program-find-inverse-matrix/

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 3 | - | 2 | 3 | 2 | 3 | - | 2 | 2 | 3 | - | - | K1 |
| CO2 | - | 3 | - | 2 | 3 | 2 | 3 | - | 2 | 2 | 3 | - | - | K2 |
| CO3 | - | 2 | - | 2 | 3 | 2 | 2 | - | - | 3 | 3 | - | - | K3 |
| CO4 | - | - | 2 | 2 | 3 | 2 | 3 | - | - | - | 3 | 2 | - | K4 |
| CO5 | - | - | 3 | 2 | 3 | 2 | 3 | 2 | - | - | 3 | 2 | 2 | K5,K6 |
| Wt. Avg. | - | 2.7 | 2.5 | 2 | 3 | 2 | 2.8 | 2 | 2 | 2.3 | 3 | 2 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO 2.4 | | |
| | | | | | | | | | | | | PSO 2.26 | | |

# ACTUARIAL STATISTICS

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **3** | | |
| **Hours / Cycle** | **4** | | |
| **Category** | **Part IV** | **Inter Disciplinary** | **Theory** |
| **Semester** | **III** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To impart basic concepts in actuarial studies**<br>**2. To prepare students to take up a career in Actuarial Practice**<br>**3. To explore some of the fiscal and ethical dilemmas often encountered in the process of business decision-making.** | | |
| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Spell financial risks in the insurance and finance fields, using mathematical and statistical methods** | **PSO1** | **K1** |
| **CO2** | **Understand to apply the probability and statistics concepts to analyze and solve the financial impact of uncertain future events.** | **PSO1**<br>**PSO2** | **K2** |
| **CO3** | **Apply knowledge in foundational areas of mathematics as well as finance and economics essential to the actuarial field.** | **PSO2**<br>**PSO3** | **K3** |
| **CO4** | **Analyze precisely and effectively by developing mathematical and critical thinking models** | **PSO4** | **K4** |
| **CO5** | **Determine and explain the ethical dilemmas encountered in the process of business decision-making.** | **PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Effective RateofInteresti-NominalRateofInteresti$^{(m)}$-ForceofInterest δ-Relationshipsbetweendifferentratesofinterest-Expressionforδbyuseofcalculus-Presentvalues-Effective rateofdiscountd-Nominalrateofdiscountd$^{(m)}$ | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Annuities -Immediate Annuity-Annuity-due -Perpetuity-AccumulationandPresentvaluesofAnnuities-Increasing andDecreasing annuities-Annuitiesandinterestrateswithdifferentfrequencies-ContinuousAnnuities | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Analysis ofAnnuitypayments-Capitaland InterestelementsincludedintheAnnuitypayments-Loanoutstanding aftertpayments-Purchase price ofAnnuities-Annuitiesinvolvingincometax-Purchase price ofanannuitynetoftax. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Principles of insurances - Types of assurance: Temporary assurance, Pure endowment, Endowment assurance and whole life assurance – Expression for present value of assurance benefits under - Temporary assurance, Pure endowment, Endowment assurance and whole life assurance – Simple problems. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | .Probabilities oflivinganddying-Theforceofmortality$\mu_x$-Estimationof$\mu_x$-UniformDistributionofdeaths-Selectand Ultimaterates. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**


1. MathematicalBasisofLifeAssurance(IC81)(2005),PublishedbyInsuranceInstituteofIndia,Bombay
2. Dixit,S.P.,Modi,C.S.&Joshi,R.V.MathematicalBasicsofLifeAssuarnce.Insurance Instituteof India,Mumbai
3. McCutcheonJ.J.and Scott.(1989).Mathematicsof Finance.Heinemann,London.Neill,A(1977). Life Contingencies.Heinemann,London


**References**


1. Frenk Ayres, J. R (1983). Theory and Problems of Mathematics of Finance**.** Schaum's Outline Series, McGraw-Hill book Company, Singapore.
2. Benjamin and pollard, J. H (1980), Analysis of Mortality and other Actuarial Statistics**,** Second Edition, Heinemann, London


**Suggested Reading**


1. Gupta, S. C and Kapoor, V. K (2020), Fundamentals of Applied Statistics**,** Sultan Chand andSons, New Delhi.
2. Shaillaja R Deshmuk (2009), Actuarial Statistics an Introduction using R**,** University Press, India.

**Web Resources**

1.https://medium.com/@mmahajan8/applications-of-actuarial-science-beyond-insurance-730b6ba8623e
2. https://actuaries.org.uk/standards/quality-assurance-scheme-qas/assurance-for-insurance/
3. https://www.thebalancemoney.com/what-is-an-insurance-actuary-4171820

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 3 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO2 | - | 3 | - | - | 2 | 2 | 3 | - | 1 | 2 | - | -- | | K2 |
| CO3 | - | - | - | 2 | 2 | - | 3 | - | - | - | 3 | - | - | K3 |
| CO4 | - | - | 2 | - | - | 2 | 3 | - | - | - | - | 3 | - | K4 |
| CO5 | - | - | 2 | - | - | - | - | 2 | - | - | - | - | 3 | K5,K6 |
| Wt. Avg. | - | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO-2.28 | | |
| | | | | | | | | | | | | PSO-2.6 | | |

# SEMESTER-IV

# THEORY OF ESTIMATION

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **4** | | |
| **Category** | **Part -III** | **Core** | **Theory** |
| **Semester** | **IV** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To understand the properties of good estimators and importance of minimum variance unbiased estimators with theorem and problems.**<br>**2. To find the point and interval estimators for better understanding of the population parameters in sample study.**<br>**3. To describe the estimators with prior knowledge of the estimators in the population constraints for decision making** | | |
| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Study the basic concepts of estimators, methods of classical and Bayesian estimators.** | **PSO1** | **K1** |
| **CO2** | **Understand the importance of the minimum variance unbiased estimators and classical and Bayesian estimators** | **PSO2** | **K2** |
| **CO3** | **Apply the methods of estimation to find the unbiased and minimum variance unbiased estimators.** | **PSO3** | **K3** |
| **CO4** | **Analyze the sample constraints and draw the inference about the population parameters.** | **PSO4** | **K4** |
| **CO5** | **Evaluate the inference drawn from the classical and Bayesian estimators for the further study.** | **PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Introduction - Estimator - Properties of Good Estimator - Unbiasedness – Biased Estimator - Mean Square Error– Consistency – Properties - Sufficient Conditions for Consistency | **10** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Minimum Variance Unbiased (MVU) Estimator - Uniqueness of MVU Estimator - Cramer - Rao Inequality and its Importance - Minimum Variance Bound (MVB) estimator - Condition for MVB estimators to exist | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Sufficiency – Completeness - Factorisation Theorem - Rao–Blackwell Theorem – Lehman Scheffe Theorem – Efficiency | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Methods of Estimation: Maximum Likelihood Estimation - Properties of Maximum Likelihood Estimation (without proof) - Moment Estimation – Minimum $\chi^2$Estimation - Modified Minimum $\chi^2$Estimation - Least Square Estimation-Simple Problems | **14** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Bayesian Estimation: Elements of Bayes' Estimation – Prior and Posterior Distributions - Loss Functions – Bayes Risk. (Definitions Only)<br>Interval Estimation: Introduction - Confidence Intervals for Mean (Known S.D. & Unknown SD), Confidence Intervals for difference of Means - Confidence Intervals for Variance and Ratio of Variances. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**


1. Gupta, S. C and Kapoor, V. K (2002), Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi. (Chapter 17)
2. Goon, A. M., Gupta, M.K., and Dasgupta, B. (1980), An Outline of Statistical Theory (Volume II), The World Press Private Limited, Calcutta. (Chapter 1, Chapter 2 & Chapter 3)
3. Mood, A. M, Graybill, F. A andBoes, D. C (1998), Introduction to the Theory of Statistics, McGraw-Hill, New York. (Chapter 11)
4. Sinha, S.K., (1998), Bayesian Estimation, New Age International Publishers. (Chapter 1)


**References**


1. Manoj Kumar Srivastava, Abdul Hamid khan and Namita Srivastava (2014), Statistical Inference: Theory of Estimation, PHI Learning Private Limited, New Delhi.
2. Rajagopalan, M and Dhanavanthan. P (2012): Statistical Inference, PHI Learning Private Limited, New Delhi.

**Suggested Reading**

1. Rohatgi, V.K. and Saleh, A.K.M.E., (2009), An Introduction to Probability and Statistics, Wiley Series, India Edition.
2. Hogg, R. V and Craig, A. T (2002), Introduction to Mathematical Statistics, Pearson Education Asia, India.

**Web Resources**

1. https://www.youtube.com/watch?v=53ONuP3XMnA
2. https://www.youtube.com/watch?v=WR62a78_H0s
3. https://www.youtube.com/watch?v=9i6QhqmJ5zg
4. https://www.youtube.com/watch?v=iMjDOTIb3-Q
5. https://www.youtube.com/watch?v=yWGedZjAFCI
6. https://www.youtube.com/watch?v=LKB4yM9jQMY
7. https://dcpehvpm.org/E-Content/Stat/E%20L%20Lehaman.pdf

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 3 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO2 | - | 3 | - | - | 3 | 3 | 3 | - | - | 3 | - | - | - | K2 |
| CO3 | - | - | - | 3 | 3 | - | 3 | - | - | - | 3 | - | | K3 |
| CO4 | - | - | 3 | - | - | 3 | 3 | - | - | - | - | 3 | - | K4 |
| CO5 | - | - | 3 | - | - | - | - | 3 | - | - | - | - | 3 | K5,K6 |
| Wt. Avg. | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO-3 | | |
| | | | | | | | | | | | | PSO-3 | | |

# SAMPLING TECHNIQUES

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | 4 | | |
| **Hours / Cycle** | 4 | | |
| **Category** | Part-III | Core | Theory |
| **Semester** | IV | | |
| **Year of Implementation** | From the academic year 2023_2024 onwards | | |
| **Course Objectives** | 1. To introduce the concept of census and sample surveys.<br>2. To learn various methods of sampling<br>3. Study the properties of estimators under different sampling methods | | |

| CO | Course Outcome(s) | PSO Addressed | Bloom's Taxonomy Levels (K1 to K6) |
|---|---|---|---|
| On completing the course successfully, the student will be able to | | | |
| CO1 | Define the basic concepts of sample surveys | PSO1<br>PSO2 | K1 |
| CO2 | Demonstrate various methods of sampling for estimating population information using sampling | PSO1<br>PSO2 | K2 |
| CO3 | Apply sampling techniques in real life problems | PSO1<br>PSO2<br>PSO4 | K3 |
| CO4 | Analyse the unbiasedness and efficiencies of estimates obtained using different sampling techniques. | PSO1<br>PSO2<br>PSO4 | K4 |
| CO5 | Identify merits and limitations of sampling techniques in real time surveys | PSO1<br>PSO2<br>PSO4<br>PSO5 | K5,K6 |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Census and sample survey-Advantages and disadvantages of sampling-Principles of sampling theory-Probability and Non-probability sampling-Planning of large-scale sample surveys – Methods of measurements –Questionnaire versus Schedule – The Frame – The Pretest – Integrated multi-subject survey – Operationsrequired for survey analysis –Sources of sampling and non-sampling errors. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Simple random sampling- Procedures of selecting a random sample -Properties of the estimates and their variances - The finite population correction –Estimation of the standard error from a sample – Confidence limits-Random sampling with and without replacement | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Sampling proportions and percentages – Qualitative characteristics - Variances of the sample estimates – The estimation of sample size- Formulae for n – Inverse sampling-Sample size with more than one item. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Stratified random sampling - Principles and advantages of stratification - Properties of the estimates and their variances - Optimum allocation in Stratified Sampling - Proportional allocation – Relative precision of Stratifiedrandom and simple random sampling - Estimation of gain in precision due to stratification - Stratified Sampling for proportions. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Systematic Sampling - Advantages and disadvantages-Variance of the estimated mean- Comparison ofsystematic sampling with simple random sampling - Comparison of systematic with stratified random sampling -Populations with linear trend - Circular systematic sampling - Single-stage cluster sampling with clusters ofequal sizes – Variance in terms of intra cluster correlation- Relative efficiency of cluster sampling-Cluster sampling for proportions. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Cochran, W.G. (1977). Sampling Techniques, Third Edition, John Wiley & Sons, NY.

**References**


1. ParimalMukhopadhyay (2009),TheoryandMethodsofSurveySampling, Prentice Hall of India, NewDelhi.
2. Singh D., and Chowdhary, F. S. (2018). Theory and Analysis of Sample Survey Design, New Age International Private Ltd., New Delhi.
3. Gupta, S.C., and Kappor, V. K. (2019). Fundamentals of Applied Statistics, Fourth Edition, Sultan Chand & Sons (Publisher), New Delhi, India.


**Suggested Reading**


1. Murthy, M. N. (1967). Sampling Theory and Methods, Statistical Publishing Society, Calcutta.Sukhatme, P. V., and Sukhatme, B. V. (1970). Sampling Theory of Surveys with Applications, Asia Publishing House, New Delhi


**Web Resources**

1. http://ocw.jhsph.edu/courses/statmethodsforsamplesurveys/pdfs/lecture2.pdf
2. https://www.questionpro.com/blog/stratified-random-sampling/
3. https://www.scribbr.com/methodology/systematic-sampling/

| | Course Articulation Matrix | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 3 | - | - | 2 | 2 | 2 | - | 2 | 3 | - | - | - | K1 |
| CO2 | - | 3 | - | - | 2 | 2 | 2 | - | 2 | 3 | - | - | - | K2 |
| CO3 | - | 3 | 2 | | 2 | 2 | 2 | - | 2 | 3 | - | 3 | | K3 |
| CO4 | - | 3 | 2 | - | 2 | 2 | 2 | - | 2 | 3 | - | 3 | - | K4 |
| CO5 | - | 3 | 2 | - | 2 | 2 | 2 | 2 | 2 | 3 | - | 3 | 3 | K5,K6 |
| Wt. Avg. | - | 3 | 2 | - | 2 | 2 | 2 | 2 | 2 | 3 | - | 3 | 3 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO-2.17 | | |
| | | | | | | | | | | | | PSO-2.75 | | |

# MAJOR PRACTICAL - II

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **2** | | |
| **Hours / Cycle** | **2** | | |
| **Category** | **Part III** | **Core** | **Practical** |
| **Semester** | **III & IV** | | |
| **Year of Implementation** | **From the academic year 2023_2024** | | |
| **Course Objectives** | **1. To impart the knowledge of various discrete and continuous distributions to real life applications**<br>**2. to provide practical knowledge about parameters estimation with practical problems.**<br>**3. To provide practical knowledge of various sampling techniques** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Relate the statistical techniques to real world problems.** | **PSO1** | **K1** |
| **CO2** | **Illustratethe appropriate distribution and testing its goodness of fit.** | **PSO2** | **K2** |
| **CO3** | **Choose the test procedure for large & small sample and infer the data.** | **PSO3** | **K3** |
| **CO4** | **Examine the concept of interval estimation and fixing the confidence interval of parameter of various distributions** | **PSO4** | **K4** |
| **CO5** | **Choose the sampling metbods in sample surveys and selecting appropriate sampling Techniques and knowledge about comparing various sampling techniques.** | **PSO4**<br>**PSO5** | **K5,K6** |

## EXCERICES

**I Fitting of discrete distributions and testing the goodness of fit :**

1. Binomial distribution(when the coin is unbiased)
2. Binomial distribution(when the coin is biased)
3. Poisson distribution
4. Geometric distribution
5. Negative Binomial distribution
6. Normal distribution (Area method)
7. Normal distribution ( Ordinate methods)
8. Exponential Distribution

**II Estimation of parameters by the method of moments and maximum likelihood for**

9. Binomial distribution
10. Poisson distribution
11. Normal distribution

**III Derivation of confidence intervals for the parameters of**

12. Population mean
13. Difference of mean
14. Population variance
15. Ratio of variance

**IV Sampling theory**

16. Simple random sampling and Estimates
17. Sampling for proportion
18. Stratified random sampling and Estimates
19. Optimum and proportional allocations
20. Systematic sampling and Estimates
21. Single stage Cluster sampling

.

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 3 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO2 | - | 1 | - | - | 1 | 2 | 2 | - | - | 3 | - | - | - | K2 |
| CO3 | - | - | - | 2 | 3 | - | 2 | - | - | - | 3 | - | - | K3 |
| CO4 | - | - | 2 | - | - | 2 | 2 | - | - | - | - | 3 | | K4 |
| CO5 | - | - | 2 | - | - | 2 | 2 | 2 | - | - | - | 2 | 2 | K5, K6 |
| Wt. Avg. | - | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2.5 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO- 2 | | |
| | | | | | | | | | | | | PSO- 2.7 | | |

# DATA ANALYSIS USING SPSS & SQL

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **4** | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **IV** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To make Students familiar in using Statistical Package for Social Sciences (SPSS) and Structured Query Language (SQL).<br>2. To gain knowledge how to use SPSS and SQL programming.<br>3. To understand the applications of SPSS and SQL in analyzing statistical data** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Recall the basics of using statistical software SPSS and SQL** | **PSO1<br>PSO3** | **K1** |
| **CO2** | **Understand the concept of reading, manipulating and analyzing data using these packages.** | **PSO1<br>PSO2<br>PSO3** | **K2** |
| **CO3** | **Choose the appropriate statistical test for the given data set to solve the problem** | **PSO3<br>PSO4** | **K3** |
| **CO4** | **Analyze the results obtained by using these packages** | **PSO3<br>PSO4<br>PSO5** | **K4** |
| **CO5** | **Evaluate and develop plan of action to the results obtained** | **PSO2<br>PSO3<br>PSO4<br>PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Data handling: Opening a data file in SPSS data file – SPSS Data editor – Editing and manipulating data – Missing values – Editing SPSS output - Copying SPSS output – Importing Data.<br>Transforming Variables: Recoding Variables: Dichotomies and dummy variable – Using two or more variables to create a new variable – Computing the variable – Using the count function – Computing an index using the mean - Multiple response - Targeted Selection - Random Selections - Selecting cases for inclusion in a New data sheet. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Diagrammatic representation: Bar Charts - Simple Bar Charts – Clustered Bar Chart – Error Bar Chart - Pie Chart – Scatter Plots – Line Graphs – Histogram– Box plot. Descriptive Statistics: Measures of Central Tendency, Measures of Dispersion - Skewness-Kurtosis. | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Correlation: Simple, Partial and Multiple Correlation, and Spearman's Rank Correlation, Regression analysis: Simple and Multiple linear Regression | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | SQL: Data Definition Language-Data Manipulation Language- Data Control Language -Difference between SQL and NoSQL. Database: Database Objects-Database Tables,-Table Records- Types of Database Management Systems - Relational Database Management Systems, SQL Data Types : Numeric,Date and Time, Character, String, Binary, Miscellaneous data types.<br>SQL Operators- Arithmetic, Comparison, Logical, Bitwise.SQL Expressions - Boolean, Numeric, Date. Comments - Single Line.<br>Data Definition Language command and operations: CREATE, ALTER, DROP, TRUNCATE, and RENAME.<br>Data Manipulation Language Commands and Operations: SELECT, INSERT, UPDATE, and DELETE.<br>Data Control Language Commands: GRANT and REVOKE | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | SQL functions - Aggregate functions, String Functions, Date Functions<br>Aggregate Functions - Min, Max, Sum, Avg, Count, Distinct. String Functions: Char, Left, Len, Lower, trim,<br>Date Functions: DateAdd, DateDiff, Datepart, current_timestamp, Isdate | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

| | | | | |
|---|---|---|---|---|
| | Functions: In, Between, And, or, Not, Group by, Having, Order By, Like, Is Null, Is not null, cast<br>Ranking Window Functions - row_number, rank(), dense_rank()<br>Analytical Functions: first_value, Last_value, Lead, Lag<br>SQL Joins - inner join, Left Join, Right Join, Full and UNION.Views and Transactions. Difference between Sql Query and Sub Query | | | |

**Prescribed Books/Textbooks**


1. Rajathi. A and P Chandran (2010). SPSS for you. MJP Publishers.
2. Field A (2013). Discovering Statistics Using SPSS.SAGE Publication.
3. Cunningham,B.J (2012). Using SPSS : An Interactive Hands-on Approach. SAGE south India Edition
4. Thomas Nield (2016) . Getting Started with SQL: A Hands-On Approach for Beginners. O'Reilly Media, Inc.
5. Gordon S.Linoff( 2008). Data Analysis using SQL and Excel. John Wiley & Sons Inc.
6. Alan Beaulieu (2020). Learning Sql Generate, manipulate and Retrieve Data, O'Reilly Media, Inc.


**References**


1. Brian C. Cronk (2017) .HOW TO USE SPSS: A Step-By-Step Guide to Analysis and Interpretation. RoutledgePublilshers.
2. SarmaK..V. S (2010). Statistics made simple: do it yourself on PC. PHI
3. Nancy L. Leech et. al., (2005) : SPSS for Intermediate Statistics: Use and Interpretation, Second edition, Lawrence Erlbaum Associates, Inc.
4. Walter Shields (2019). SQL Quick Start Guide: The Simplified Beginner's Guide to Managing, Analyzing, and Manipulating Data With SQL. Clyde Bank Media LLC
5. Anthony Molinaro (2005). SQL Cookbook. O'Reilly Media, Inc.


**Suggested Reading**


1. William E. Wagner (2015). Using IBM SPSS statistics for research methods and social science statistics. SAGE Publications Inc.
2. LokeshJasrai, (2020). Data Analysis Using SPSS, SAGE Publications India Pvt Ltd
3. Anthony DeBarros(2018). Practical SQL A Beginner's Guide to Storytelling with Data. No Starch Press
4. Sylvia MoestlVasilik (2016). SQL Practice Problems: 57 Beginning, Intermediate, and Advanced Challenges for You to Solve Using a "learn-by-doing" Approach


**Web Resources**

1. https://www.youtube.com/watch?v=0S89RyIVu2k
2. https://www.youtube.com/watch?v=ZpwZS3XnEZA
3. https://www.classcentral.com/classroom/freecodecamp-spss-for-beginners-full-course-104934
4. SQL Course from Khan Academy
5. SQL Tutorial - Full Database Course for Beginners YouTube video
6. SQlbolt.com
7. sqlzoo.net

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 2 | - | 2 | 3 | - | 2 | - | 2 | - | 2 | - | - | K1 |
| CO2 | - | 2 | - | 2 | 3 | 2 | 2 | - | 2 | 2 | 2 | - | - | K2 |
| CO3 | - | - | 2 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | - | K3 |
| CO4 | - | - | 2 | 2 | 3 | 2 | 2 | 2 | - | - | 2 | 2 | 3 | K4 |
| CO5 | - | 2 | 2 | 2 | 3 | 2 | 2 | 2 | - | 2 | 2 | 2 | 3 | K5, K6 |
| Wt. Avg. | - | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO- 2.14 | | |
| | | | | | | | | | | | | PSO- 2.2 | | |

## ALLIED PRACTICAL – II

| Course Code | | | |
|---|---|---|---|
| Credits | 2 | | |
| Hours / Cycle | 2 | | |
| Category | Part III | Allied | Practical |
| Semester | III & IV | | |
| Year of Implementation | From the academic year 2023_2024 onwards | | |
| Course Objectives | 1. To familiarize with Programming language C & SQL and to handle SPSS package<br>2. To explore statistical data analysis using C programming and SPSS package<br>3. To solve problems using C programming, SPSS package and SQL | | |
| CO | Course Outcome(s) | PSO Addressed | Bloom's Taxonomy Levels (K1 to K6) |
| On completing the course successfully, the student will be able to | | | |
| CO1 | Recall the basic knowledge of programming skills in C and SQL and to acquire knowledge in using SPSS package | PSO1<br>PSO3 | K1 |
| CO2 | Demonstrate the use of C,SPSS and SQL in solving statistical problems | PSO2<br>PSO3 | K2 |
| CO3 | Choose the appropriate statistical test for the given data set to solve the problem | PSO3<br>PSO4 | K3 |
| CO4 | Analyze the results obtained by using the programming language and package. | PSO3<br>PSO4 | K4 |
| CO5 | Evaluate and Interpret the results obtained | PSO3<br>PSO4<br>PSO5 | K5,K6 |

## EXCERICES

### Semester I- Programming in C

1. Minimum, Maximum, Range, Coefficient of range.
2. Mean and Median- Raw and Frequency data.
3. Geometric mean and harmonic mean.
4. Quartile deviations, Variance, Standard Deviation
5. Coefficient of Quartile deviations and Coefficient of variance.
6. Skewness, Bowley's coefficient of skewness, first four moments.
7. Simple correlation Coefficient
8. Fitting of Simple linear regression.
9. Matrix operations: Addition, Subtraction and Multiplication
10. Matrix operations: Trace, Transpose and Inverse of matrix.

### Semester II-SPSS & SQL

1. Data handling and transformation of variables
2. Diagrammatic Representation
3. Measures of Central Tendency and Dispersion
4. Simple, Partial and Multiple correlation, Rank correlation
5. Simple and multiple linear regression
6. Query using Analytical and aggregate functions
7. Query using Joins and filtering statement
8. Query to find the duplicate row count from specific table using window partition
9. Query to find the column/row with null value and replace it with a constant
10. Query to find the frequently used item

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 2 | - | 2 | 3 | - | 2 | - | 2 | - | 2 | - | - | K1 |
| CO2 | - | 2 | - | 2 | 3 | 2 | 2 | - | - | 2 | 2 | - | - | K2 |
| CO3 | - | - | 2 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | - | K3 |
| CO4 | - | - | 2 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | | K4 |
| CO5 | - | - | 2 | 2 | 3 | 2 | 2 | 2 | - | - | 2 | 2 | 2 | K5, K6 |
| Wt. Avg. | - | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO-2.14 | | |
| | | | | | | | | | | | | PSO-2 | | |

# Environmental studies (UGC syllabus)

# SEMESTER-V

# OPERATIONS RESEARCH

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **5** | | |
| **Hours / Cycle** | **5** | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **V** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1.Classify and improve operational Research models from the verbal description of the real system<br>2. Understanding the mathematical tools that are needed to solve optimization problems.<br>3. Ability to understand and analyze managerial problems in industry to use the recourses more effectively.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Introduce the basic concepts of Operations Research and Linear Programming Problem.** | **PSO1** | **K1** |
| **CO2** | **Equip Studetns with Optimization techniques and make them to solve decision making problems based on Deterministic and Probabilistic models** | **PSO1<br>PSO2** | **K2** |
| **CO3** | **Design a mathematical model for an optimization problem in real life by adopting the techniques of operations research.** | **PSO3** | **K3** |
| **CO4** | **Evaluate the concepts in linear programming and game theory and to estimate the optimal schedule of a project.** | **PSO4** | **K4** |
| **CO5** | **Analyse the optimization techniques of linear programming, theory of games and network analysis in solving real world problems.** | **PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | IntroductiontoOperationsResearch–O.R. models–PhasesofanO.R.study,Linearprogramming–Formulation–Graphical solution. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Simplexmethod–ArtificialVariables–Penaltymethod–Two-Phasemethod–SpecialcasesinLPP– Dual problemsand Dualitytheory. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Transportation models : Definition – Initial solution by North West Corner method – LeastCostEntrymethod–Vogel'sApproximationmethod–OptimalsolutionusingMODImethod– Unbalanced problems– Degeneracy.AssignmentmodelDefinition–SolutionbyHungarianAlgorithm | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | SequencingProblems:Assumptions–**'n'** jobsthroughtwo machines- **'n'** jobsthrough '**m'**machinesGametheory:Rectangulargame–Optimalsolutionofatwo-personzerosumgame-Dominance rules– Solution of mixed strategy game by Algebraic method, Graphical methodandLinear Programming Method. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Critical Path Method - Network Diagram – Determination of the floats- Evaluation of criticalpath. PERT–Differenttimeestimates –Probabilityconsiderations. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**


1. Hamdy,ATaha,(2005),OperationsResearch,AnIntroduction,8th edition,MacmillanPublishingCo.
2. Kapoor,V.K(2008),OperationsResearch–QuantitativeTechniquesforManagement,8th edition,Reprint–2010,SultanChand and Sons


**References**


1. KanthiSwarup,GuptaP.KandManmohan(2003),ProblemsinOperationsResearch,SultanChand and Sons, NewDelhi.
2. Gupta,P.KandHira,D.S,(1986),OperationsResearch-AnIntroduction,SultanChandand Sons, NewDelhi.
3. F.S. Hillier and G.J. Lieberman : Introduction to Operations Research- Concepts andCases,9th Edition, Tata McGrawHill.2010.
4. MartinOsborne,AnIntroductiontoGameTheory, OxfordUniversityPress,2003.


**Suggested Reading**


1. Michael Carter, Camille C. Price& GhaithRabadi (2018) Operations Research -A Practica Introduction CRC Press
2. Kalavathy S. (2000) . Operations Research, 4th Edition, Vikas Publishing House


**(40% theory and 60% practical)**

**Web Resources**

1. https://www.bbau.ac.in
2. https://www.informs.org/Resource-Center/Resources-for-Instructors/Resources-for-Operations-Research-Instructors

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO 1 | - | 3 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO 2 | - | 2 | - | - | 2 | 3 | 3 | - | 2 | 3 | - | -- | | K2 |
| CO 3 | - | - | - | 2 | 2 | - | 3 | - | - | - | 3 | - | - | K3 |
| CO 4 | - | - | 2 | - | - | 2 | 3 | - | - | - | - | 3 | - | K4 |
| CO 5 | - | - | 2 | - | - | - | - | 2 | - | - | - | - | 3 | K5,K6 |
| Wt. Avg. | - | 2.5 | 2 | 2 | 2 | 2.5 | 3 | 2 | 2.5 | 3 | 3 | 3 | 3 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO-2.28 | | |
| | | | | | | | | | | | | PSO-2.9 | | |

# TESTING OF HYPOTHESIS

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **5** | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **V** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To provide theoretical understanding of Statistical Inference procedures.<br>2. To carry out the test procedures and obtain the best test with minimum possible errors for any given null and alternative hypothesis.<br>3. Introduce main ideas and principles behind the non-parametric inference procedures.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | Recall the basic concepts of testing of hypothesis and hypothesis testing when null and alternative is simple using N.P. Lemma | **PSO1<br>PSO2** | **K1** |
| **CO2** | Classify UMPT for various distribution when alternative is composite. Illustrate one parameter exponential families of distributions and outline monotone likelihood property. | **PSO1<br>PSO2** | **K2** |
| **CO3** | Develop the best test using Likelihood Ratio Test when null and alternative may be simple or composite for mean and variance of Normal distribution. | **PSO2<br>PSO3** | **K3** |
| **CO4** | Examine the concept of test of significance and carryout test procedure for real life situation problem. | **PSO3<br>PSO4** | **K4** |
| **CO5** | Evaluate the test procedure corresponding to distribution free tests with respect to Mean, Median, and Goodness of fit and one way ANOVA. | **PSO4<br>PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Simple and composite hypotheses – Null hypothesis and alternative hypothesis – Test - Critical region– Type I error and Type II error – Power of the test – Steps involved in solving testing statisticalhypothesis – Most Powerful Test – Neymann–Pearson Lemma – Simple applications. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Most Powerful Test for the parameters of binomial, Poisson normal and exponential distributions –Critical regions and sufficient statistics – Uniformly Most Powerful Tests – Power function and powercurve – UMP tests for the parameters of univariate binomial, Poisson, normal and exponentialdistributions. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Likelihood Ratio Test (LRT) : Definition of LRT - Properties of LRT tests (Statements only) – LRT for the mean and LRT of the variance of univariate normal population – Test for equality of means of2 independent univariate normal populations with common unknown variance – Test for equality ofvariances of 2 independent univariate normal populations. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | One-tailed and two-tailed tests – Large Sample Test: Tests of significance of proportion, Differenceof proportions, mean, Difference of means, standard deviation and difference of standard deviations– Small sample Test: t (except Test for partial and multiple correlation coefficient) and F – Univariatenormal distributions and correlation coefficient. Homogeneity of variances of normal distributions –Homogeneity of correlation coefficients. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Non parametric tests: Test of Randomness of a sample – Sign test for one sample and 2 samples – Wilcoxon Signed rankedtest for one sample and 2 samples – Median test – Mann-Whitney–U-test – Wald - Wolfowitz Run Test – Kruskal-Wallis Test – Test of independence of attributes. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Gupta, S. C and Kapoor , V. K (2002), Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi (Relevant Chapters and Sections only).
2. M. Rajagopalan, P. Dhanavanthan(2012). Statistical Inference, PHI Learning Pvt. Ltd.,

**References**

1. Hogg, R. V and Craig, A. T (2002), Introduction to Mathematical Statistics, Pearson Education Asia, India.
2. Mood, A. M, Graybill, F. A and Boes, D. C (1998), Introduction to the Theory of Statistics, McGraw-Hill, New York.
3. Beaumont, G.P. (1980): Intermediate mathematical Statistics, Chapman and Hall, New York.

**Suggested Reading**

1. https://web.stanford.edu/class/archive/stats/stats200/stats200.1172/Lecture01.pdf
2. Rohatagi, V.K. (1976): An Introduction to Probability and Statistics, John Wiley & Sons. (for unit 5-Section 8.8 only)

**Web Resources**

1. https://nptel.ac.in/courses/111/105/111105043/
2. https://nptel.ac.in/courses/111/102/111102143/
3. https://nptel.ac.in/courses/111102143

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 3 | - | - | 2 | 2 | 2 | - | 2 | 2 | - | - | - | K1 |
| CO2 | - | 3 | - | - | 2 | 2 | 2 | - | 2 | 2 | - | - | - | K2 |
| CO3 | - | 2 | - | 2 | 3 | 2 | 3 | - | - | 2 | 2 | - | - | K3 |
| CO4 | - | - | 2 | 2 | 2 | 2 | 3 | - | - | - | 2 | 2 | - | K4 |
| CO5 | - | - | 3 | - | - | 2 | 2 | 2 | | - | - | 2 | 3 | K5,K6 |
| Wt. Avg. | - | 2.7 | 2.5 | 2 | 2.25 | 2 | 2.8 | 2 | 2 | 2 | 2 | 2 | 3 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO-2.32 | | |
| | | | | | | | | | | | | PSO-2.2 | | |

# APPLIED REGRESSION ANALYSIS

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **5** | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **V** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1.To outline Multiple Regression Models.**<br>**2. Detection and Transformation to Linearity models.**<br>**3.Multicollinearity and its effects on inference and forecasting.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Recall about correlation concepts and derive partial and multiple correlation coefficients.** | **PSO1 PSO2** | **K1** |
| **CO2** | **Outline about simple Linear Regression Modelswith examples.** | **PSO2** | **K2** |
| **CO3** | **Construct Multiple Linear Regression models and testing it.** | **PSO2 PSO3** | **K3** |
| **CO4** | **Analyze the model violations and Linear Transformations.** | **PSO4 PSO5** | **K4** |
| **CO5** | **Explain about Multicollinearity, Ridge Method-forward selection and backward elimination** | **PSO4 PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Partial and Multiple correlation coefficients – Relationships among simple, partial and multiple correlation coefficients. | **10** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Simple Linear Regression : Introduction, applications of regression analysis, steps in regression analysis, simple linear regression model, parameter estimation, tests of hypothesis, confidence interval, predictions, measuring the quality of fit, regression line through the origin. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Multiple Linear Regression: Introduction, Description of the data and model, parameter estimation, interpretations of regression coefficients, properties of the least squares estimatiors, multiple correlation coefficient, inference for individual regression coefficients, tests of hypothesis in a linear model, predictions. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Detection of model violations: Introduction, standard regression assumptions, types of residuals, Graphical methods – Before and After fitting a model, checking linearity and normality assumptions, leverage, influence and outliers, transformation of variables: introduction, transformations to achieve linearity, transformations to stabilize variance, detection of heteroscedastic errors, removal of heteroscedasticity, weighted least squares, logarithmic transformation of data. | **20** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Multicollinearity and its effects on inference and forecasting- Detection of Multicollinearity – searching of linear functions of regression coefficients- Ridge Method, selection of variables-forward selection and backward elimination- Stepwise method (algorithms only). | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**


1. Gupta S.C and Kapoor V.K. (2003), Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
2. Samprit Chatterjee, Ali S. Hadi, Bertram Price (2000), Regression Analysis by Example, Wiley Series.
3. Chatterjee S and Price B (1977) Regression Analysis by Example, John Wiley and Sons.
4. Gujarati, D. (2014). Econometrics by example. Bloomsbury Publishing.


**References**


1. Johnson Jr, A. C., Johnson, M. B., &Buse, R. C. (1987). Econometrics: Basic and applied. New York
2. Draper N and Smith H (1998), Applied Regression Analysis , 3 rd edition, John Wiley and Sons.
3. Montgomery,D.C. ,Peck E.A, & Vining G.G. (2003), Introduction to Linear Regression Analysis, John Wiley and Sons,Inc.NY.


**Suggested Reading**


1. Draper, N. R. & Smith, H (1998), Applied Regression Analysis, John Wiley, 3rd edition.
2. Anushalllukkumbura(2020),Introduction to Regression Analysis.

**Web Resources**

1. https://youtu.be/fjGO3mrjskc
2. http://www.quora.com/How-would-linear-regression-be-described-and-explained-in-laymans-terms
3. Microsoft Word - Chapter2-Regression-SimpleLinearRegressionAnalysis (iitk.ac.in)

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | - | - | - | K1 |
| CO2 | - | 2 | - | - | 2 | 2 | 2 | - | - | 2 | - | - | - | K2 |
| CO3 | - | 3 | - | 3 | 3 | 3 | 3 | - | - | 3 | 3 | - | - | K3 |
| CO4 | - | - | 3 | - | - | 2 | 2 | 2 | - | - | - | 3 | 3 | K4 |
| CO5 | - | - | 3 | - | - | 2 | 2 | 2 | - | - | - | 3 | 3 | K5, k6 |
| Wt. Avg. | - | 2.6 | 3 | 3 | 2.6 | 2.4 | 2.4 | 2 | 3 | 2.6 | 3 | 3 | 3 | |
| Overall Mapping of the Course | | | | | | | | | | | | | PO-2.25<br>PSO-2.9 | |

# STATISTICS USING R LANGUAGE

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **5** | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **V** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To impart programming skills using R Language<br>2. The goal is to teach Exploaratory data analysis using R language<br>3. Utilize programming skills to solve real-life problem using different Statistical tools** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Define the basics of R preliminaries, Data in Statistics and in R and Exploratory data analysis.** | **PSO1<br>PSO3** | **K1** |
| **CO2** | **Understand the basic comceptsof Data in Statistics, Exploratory data analysis, Statistical tools.** | **PSO1<br>PSO2<br>PSO3** | **K2** |
| **CO3** | **Choose the right statistical test for the given data** | **PSO3<br>PSO4** | **K3** |
| **CO4** | **Apply the statistical tools in R programming** | **PS03<br>PSO4<br>PSO5** | **K4** |
| **CO5** | **Evalluate the interpretation of Statistical tools using R programming** | **PSO2<br>PSO3<br>PSO4<br>PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Basic R-Preliminaries: Modes-Vectors-Arithmetic operators and special values-Objects-Programming-Packages-Graphics-Customizing the workspace-Projects-Producing figures and output | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Data in Statistics and in R: Types of Data-Objects that hold data-Data Organization-Data import, export and connections-Data Manipulation. Presenting data: Tables-Bar plots-Histograms-Dot charts-Scatter plots-Lattice plots-Three dimensional plots and contours | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Exploratory data analysis: Graphical methods-Numerical summaries-Visual summaries- Single sample hypotheses testing: Null and alternative hypothesis-Large sample hypothesis testing-Small sample hypothesis testing-Arbitrary statistics of arbitrary densities-p values | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Power and sample size for single samples: Large samples-Small samples-Power and sample size of arbitrary densities. Two samples: Large samples-Small samples-Unknown densities. Analysis of variance: One way, fixed effects ANOVA | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Simple Linear regression: Simple linear models-Estimating regression coefficients-The model goodness of fit-Hypothesis testing and confidence interval-Model Assumptions-Model Diagnostics-Power and sample size for the correlation coefficient. Simple logistic regression: Binomial Logistic regression-Fitting and selecting models-Assessing goodness of fit-Diagnostics | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Cohen, Y., & Cohen, J. Y. (2008). Statistics and Data with R: An applied approach through examples. John Wiley & Sons.
2. Field, A., Miles, J., & Field, Z. (2012). Discovering statistics using R. Sage publications.

**References**


1. Hothorn, T., &Everitt, B. S. (2014). A handbook of statistical analyses using R. CRC press.
2. Crawley, M. J. (2012). The R book. John Wiley & Sons.
3. Lumley, T. (2011). Complex surveys: a guide to analysis using R. John Wiley & Sons.
4. Kerns, G. J. (2010). Introduction to probability and statistics usin R. Lulu. com.


**Suggested Reading**


1. Zhang, Z., & Wang, L. (2017). Advanced statistics using R. Granger, IN: ISDSA Press. Accessed on December, 3, 2021.
2. Dalgaard, P. (2008). Statics and Computing Introductory Statistics with R. Springer.
3. Schumacker, R. E. (2014). Learning statistics using R. Sage Publications.
4. Hui, E. G. M. (2019). Learn R for Applied Statistics. Eric Goh Ming Hui.
5. Venables, W. N., & Smith, D. M. (2003). An introduction to R: notes on R: a programming environment for data analysis and graphics, version 1.9.


**Web Resources**

1. https://www.math.csi.cuny.edu/~verzani/R/AMS-MAA-Jan-09.pdf
2. https://www.youtube.com/watch?v=_V8eKsto3Ug
3. https://web.itu.edu.tr/~tokerem/The_Book_of_R.pdf
4. https://www.youtube.com/watch?v=eDrhZb2onWY
5. https://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 2 | - | 2 | 3 | - | 2 | - | 2 | - | 2 | - | - | K1 |
| CO2 | - | 2 | - | 2 | 3 | 2 | 2 | - | 2 | 2 | 2 | - | - | K2 |
| CO3 | - | - | 2 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | - | K3 |
| CO4 | - | - | 2 | 2 | 3 | 2 | 2 | 2 | - | - | 2 | 2 | 2 | K4 |
| CO5 | - | 2 | 2 | 2 | 3 | 2 | 2 | 2 | - | 2 | 2 | 2 | 2 | K5, K6 |
| Wt. Avg. | - | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO- 2.14 | | |
| | | | | | | | | | | | | PSO- 2 | | |

## MAJOR PRACTICAL – III

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **2** | | |
| **Hours / Cycle** | **6** | | |
| **Category** | **Part-III** | **Core** | **Practical** |
| **Semester** | **V** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To produced basic charts and descriptives measures using R Language**<br>**2. Exploaring data analysis using R language**<br>**3. Solving real-life problem using different Statistical tools with the help of R programming** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Define the basis of R programming like vector and Data frame.** | **PSO1 PSO3** | **K1** |
| **CO2** | **Comprehend the basic ideas of Exploratory data analysis** | **PSO2 PSO3** | **K2** |
| **CO3** | **Select the right statistical test for the given data** | **PSO3 PSO4** | **K3** |
| **CO4** | **Relate the statistical tools in R programming** | **PSO3 PSO4** | **K4** |
| **CO5** | **Assess the interpretation of Statistical tools using R programming** | **PSO3 PSO4 PSO5** | **K5, K6** |

## EXCERICES

1. Operations on vectors
2. Operation on matrices
3. Creating and manipulating data frames.
4. Writing user defined functions for finding arithmetic mean, median, factorial
5. Bar and Pie charts.
6. Box plots for single and multiple groups.
7. Density and cumulative density plots for Binomial distribution
8. Density and cumulative density plots Poisson distribution
9. Density and cumulative density plots Normal distribution
10. Density and cumulative density plots Exponential distribution
11. Checking Normality using Histogram and Q-Q plot.
12. Correlation coefficient – Pearson's,
13. Spearman.
14. Fitting of simple linear regression
15. F-test for equality of Variance
16. One sample t test
17. Two independent sample t test.
18. Paired t-test
19. Chi-square test for independence of attribute
20. Test of Randomness
21. Kolmogorov Smirnov test
22. Mann-Whitney U test
23. Median test
24. Kruskal Wallis test
25. Friedman's test
26. One Way ANOVA
27. Fitting of Multiple Linear Regression
28. Logistic Regression
29. Large sample proportion test
30. Chi-square test for goodness of fit

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 2 | - | 2 | 3 | - | 2 | - | 2 | - | 2 | - | - | K1 |
| CO2 | - | 2 | - | 2 | 3 | 2 | 2 | - | - | 2 | 2 | - | - | K2 |
| CO3 | - | - | 2 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | - | K3 |
| CO4 | - | - | 2 | 2 | 3 | 2 | 2 | - | - | - | 2 | 2 | | K4 |
| CO5 | - | - | 2 | 2 | 3 | 2 | 2 | 2 | - | - | 2 | 2 | 2 | K5, K6 |
| Wt. Avg. | - | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO- 2.14 | | |
| | | | | | | | | | | | | PSO- 2 | | |

# TOTAL QUALITY MANAGEMENT

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **3** | | |
| **Hours / Cycle** | **4** | | |
| **Category** | **Part-IV** | **Elective** | **Theory** |
| **Semester** | **V** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To understand the importance of quality in modern business scenarios to individuals, organizations, customers, suppliers and society.<br>2. To identify and describe the key components and challenges of total quality management (TQM) and understand how organizations approach TQM deployment.<br>3.To demonstrate the value of understanding effective communication and behavioural styles, problem solving with the use of quality tools.** | | |
| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Study the basic concepts, tools and techniques of Total Quality Management(TQM)** | **PSO1** | **K1** |
| **CO2** | **Understand the concept of implementing the TQM to the organization** | **PSO2** | **K2** |
| **CO3** | **Apply the TQM process and design for better performance of the business scenario** | **PSO3<br>PSO5** | **K3** |
| **CO4** | **Analyze the data based approach through statistical control charts and solving problem in TQM** | **PSO4** | **K4** |
| **CO5** | **Evaluatethe data based approach through various statistical measures in TQM which helps to further study** | **PSO3<br>PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Definition of TQM – TQM Framework – Quality Movement in India – Obstacles and Benefits of TQM. Leadership: Defintion – Qulaity Leaders – concepts – Habits of Highly Effective People – Ethics. Customer Satisfiction: Customer Perception – Feedback – Employee Involvement : Teams – Empowerment. Continous Process Improvement: Improvement Strategies – Types of Problems – PDSA – Problem solving method – Kaizen – Six Sigma | **10** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Benchmarking: Defintion – Reasons – Process – Understanding the current performance. Information Technology: Computer ans the quality function – The internet and other Electronic Communication – Information Quality Issues. Quality Mangement Systems: Benefits of ISOs – Sector Specfic Standards – ISO 9001 Requirements – Implementation – ISO 14000 series standards | **13** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Failure Mode and Effect Analysis: Reliability – Reliability Requirements – Failure Rates and Product Life Cycle – Intent, Team, Documentaion, Stages, design of FMEA – Process of FMEA. | **13** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Statistical Process Control: Diagrams – Statistical Fundamental Measures – Standard Normal Distribution – Control Charts – Measurement of System Analysis | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Experimental Design: Basic Statistics – Hypothesis – Point and Interval Estimates – Factorial Design - Orthogonal Design. Taguchi's Quality Engineering: Loss Function – Orthogonal Arrays – Signal to Noise Ratio – Parameter design – Tolerance Design | **12** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Besterfield, D. H., Besterfield-Michna, C., Besterfield-Sacre, M., Besterfield, G. H.,Urdhwareshe, H., &Urdhwareshe, R. (2017). Total Quality Management, 4/e. Pearson Education India.

**References**

1. Sharma, D. D. (2004). Total quality management: principles, practice and cases. New Delhi: Sultan Chand and Sons.
2. Evans, J. R., & Lindsay, W. M. (2005). The management and control of quality, First Indian Edition, Cengage Learning.
3. Janakiraman, B., & Gopal, R. K. (2006). Total quality management: Text and cases. PHI Learning Pvt. Ltd..

**Suggested Reading**

1. Briedyte, E. (2014). The importance of Total quality management in discount grocery stores in Ireland (Doctoral dissertation, Dublin Business School).
2. Njenga, E. W. (2017). Influence of implementation of quality management system on operational performance of technical training institutions in Meru County: A case of Nkabune Technical Training Institute, Kenya (Doctoral dissertation, University of Nairobi).
3. Shoshan, A. A. A. (2016). Application of total quality management (TQM) in Turkish construction industry. Çukurova University, Master Thesis, 131p.

**Web Resources**

1. https://www.youtube.com/watch?v=5pMWmU_8lfI&list=PLPjSqITyvDeUUUwunyiwq41yJZofQEzMI
2. https://www.youtube.com/watch?v=MWQdHyDZGdY
3. https://www.youtube.com/watch?v=j1-Z2A_MGZI
4. https://www.youtube.com/watch?v=EZlbQc5-Cos
5. https://www.youtube.com/watch?v=NWkFfjJT7ME
6. https://oms.bdu.ac.in/ec/admin/contents/160_P16MBA18_2020051812512021.pdf

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 3 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO2 | - | 3 | - | - | 1 | 1 | 1 | - | - | 3 | - | - | - | K2 |
| CO3 | - | - | 3 | 1 | 1 | - | 2 | 2 | - | | 3 | - | 2 | K3 |
| CO4 | - | - | 3 | - | - | 3 | 2 | - | - | - | - | 2 | - | K4 |
| CO5 | - | - | 3 | - | 1 | - | - | - | - | - | 2 | - | 2 | K5,K6 |
| Wt. Avg. | - | 3 | 3 | 1 | 1 | 2 | 2.5 | 2 | 3 | 3 | 2.5 | 2 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO -2.07 | | |
| | | | | | | | | | | | | PSO – 2.5 | | |

# SEMESTER-VI

# DESIGN OF EXPERIMENTS

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **5** | | |
| **Hours / Cycle** | **6** | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **VI** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. Basic concepts & principles of experimental design will be introduced<br>2. The goal is to impart a sound understanding of the Analysis of Variance and Analysis of Covariance Technique<br>3. Statistical Analysis of various design like CRD, RBD, LSD, Factorial Experiment and Incomplete block design will be discussed.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Define the principles of experiment design, Analysis of Variance (ANOVA) and Analysis of Co-variance (ANOCOVA)** | **PSO1** | **K1** |
| **CO2** | **Understand the basic concepts of experimental design like CRD, RBD, LSD, Factorial design, Incomplete block design.** | **PSO1<br>PSO2** | **K2** |
| **CO3** | **Construct the statistical analysis of CRD, RBD, LSD, Factorial design, Incomplete block design and ANOCOVA** | **PSO3<br>PSO4** | **K3** |
| **CO4** | **Distinguish the difference between various designs like CRD, RBD, LSD, Factorial design, Incomplete block design** | **PSO3<br>PSO4<br>PSO5** | **K4** |
| **CO5** | **Evaluate the statistical analysis of ANOVA (one way and Two way) and ANOCOVA (CRD and RBD)** | **PSO2<br>PSO4<br>PSO5** | **K5 &K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Analysis of Variance - One-way classification - Two-way classification – Two-way classification with m-observations per cell - Statistical analysis of the models (Fixed effect only) | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Terminology in experimental designs - Principles of experimentation - Completely randomised design - Randomised block design - Latin square design - Their models - Least square estimates of the parameters and analysis - Statistical analysis of experiments (Fixed effect) - Missing plot technique for two missing values. | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Factorial experiments - Two and three level experiments ($3^2$ experiments only) - Confounding in factorial experiments - Total and partial confounding. | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Incomplete block designs - Balanced incomplete block designs - Parameters of BIBD - Intra block analysis of BIBD. | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Analysis of Covariance – One-way layout with one concomitant variable - RBD with one concomitant variable. | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**


1. Gupta, S. C., & Kapoor, V. K. (2019). Fundamentals of applied statistics. Sulthan Chand & Sons.
2. Gun, A. M., Gupta, M. K., &Dasgupta, B. (2013). Fundamentals of statistics. World Press Private.
3. Das, M. N., &Giri, N. C. (1979). Design and analysis of experiments. New Age International


**References**


1. Cobb, G. W. (1998). Introduction to design and analysis of experiments. New York: Springer.
2. Dean, A., & Voss, D. (Eds.). (1999). Design and analysis of experiments. New York, NY: Springer New York
3. Oehlert, G. W. (2010). A first course in design and analysis of experiments.
4. Eriksson, L., Johansson, E., Kettaneh-Wold, N., Wikström, C., & Wold, S. (2000). Design of experiments. Principles and Applications, Learn ways AB, Stockholm.


**Suggested Reading**


1. Cox, D. R., & Reid, N. (2000). The theory of the design of experiments. CRC Press.
2. Lawson, J. (2014). Design and Analysis of Experiments with R (Vol. 115). CRC press.
3. Federer, W. T. (1955). Experimental design, theory and application.

**Web Resources**

1. https://nptel.ac.in/courses/111104075
2. http://www.stat.tugraz.at/courses/files/DoE.pdf
3. http://home.iitk.ac.in/~shalab/anova/chapter4-anova-experimental-design-analysis.pdf
4. https://www.youtube.com/watch?v=ZgZxAX9yrSI
5. https://www.youtube.com/watch?v=IEUTRhyoHNc&list=PLPjSqITyvDeWS9Lxp4jreGJ7eNsxHxJA8

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 2 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO2 | - | 2 | - | - | 2 | 2 | 2 | - | 2 | 2 | - | - | - | K2 |
| CO3 | - | - | 2 | 2 | 2 | 2 | 2 | - | - | - | 2 | 2 | - | K3 |
| CO4 | - | - | 2 | 2 | 2 | 2 | 2 | 2 | - | - | 2 | 2 | 2 | K4 |
| CO5 | - | 2 | 2 | - | 2 | 2 | 2 | 2 | - | 2 | - | 2 | 2 | K5, K6 |
| Wt. Avg. | - | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2.5 | 2 | 2 | 2 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO-2<br>PSO-2.1 | | |

# APPLIED STATISTICS

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **6** | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **VI** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1.To study about Time Series and Index Numbers.**<br>**2. To Estabish Process Control using variable and attribute control charts.**<br>**3.The usage of sampling plans for quality check.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Define Time Series,IndexNumbers,SQC,Sampling Plans and Auto-regression.** | **PSO1** | **K1** |
| **CO2** | **Classify different types of Time series , Index Numbers , Control Charts and Sampling Plans.** | **PSO1**<br>**PSO2** | **K2** |
| **CO3** | **Construct different types of Seasonal Indices, Price Index Numbers, Control Charts and Sampling Plans.** | **PSO3**<br>**PSO5** | **K3** |
| **CO4** | **Compare the different types of Moving Averages, Price Index Numbersand Control Charts.** | **PSO2**<br>**PSO4** | **K4** |
| **CO5** | **Discuss about the Application of Time Series,IndexNumbers,SQCwith real time data set.Determine twoAuto-regressive series.** | **PSO1**<br>**PSO2**<br>**PSO4**<br>**PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Index numbers : Definition – Construction of index numbers – Problems and limitations - Interpretation of index numbers - Errors in index numbers - Tests of index numbers - Chain index - Cost of living index - Uses of index numbers- Deflating-Slicing | **17** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Introduction to time series - Analysis of time series - Uses of time series - Measurement of trend using various methods - Measurement of seasonal fluctuations by different methods - Merits and demerits of each method. | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Auto-regression : Definition - First order auto-regression – Second Order Auto-regressive series - Variate difference method and its applications. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Statistical Quality Control : Introduction to SQC - Uses, Tools, Process and Product Control - Control charts - Control charts for variables and attributes - Natural tolerance limits and specification limits. | **20** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Acceptance sampling by attributes: Rectifying inspection plans - Dodge and Romig rectifying sampling inspection plans - Single and double sampling plans for attributes - Single sampling versus Double sampling plans. | **20** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Gupta, S. C and Kapoor, V. K (2007), Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
2. ParimalMukhopadhyay (1999), Applied Statistics, Books & Allied (P) Ltd.

**References**

1. Frederick, E. Croxton, Dudley, J. Cowden and Sidney Klein, (1972) Applied General Statistics, Prentice Hall of India Pvt. Ltd, New Delhi.
2. Douglas C. Montgomery and George C. Runger,( 2016).Applied Statistics and Probability for Engineers,Wiley Publications.
3. D. R. Cox and Christl A. Donnelly,(2011)Principles of Applied Statistics,Cambridge publications

**Suggested Reading**

1. W.N.Venables and B.D.Ripley, Modern Applied Statistics with S- Plus, Springer.
2. Croxton, F.EandCowden,D.J(1984):Appliedgeneralstatistics,PrenticeHallofIndia

**NOTE :THEORY 40 % PROBLEMS 60 %**

**Problem only on Index number and time series**

**Web Resources**

1. https://www.wallstreetmojo.com/index-number/
2. https://www.britannica.com/topic/statistical-quality-control
3. https://www.sciencedirect.com/topics/engineering/statistical-quality-control

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO1 | - | 2 | - | - | - | - | - | - | 2 | - | - | - | - | K1 |
| CO2 | - | 3 | - | - | 3 | 3 | 3 | - | 3 | 3 | - | - | - | K2 |
| CO3 | - | - | 3 | 3 | 3 | - | 3 | 3 | - | - | 3 | - | 3 | K3 |
| CO4 | - | 3 | 3 | - | 3 | 3 | 3 | - | - | 3 | - | 3 | - | K4 |
| CO5 | - | 3 | 3 | - | 2 | 3 | 3 | 2 | 2 | 2 | - | 2 | 2 | K5, K6 |
| Wt. Avg. | - | 2.75 | 3 | 3 | 2.75 | 3 | 3 | 2.5 | 2.3 | 2.6 | 3 | 2.5 | 2.5 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO-2.8<br>PSO-2.58 | | |

# STOCHASTIC PROCESSES

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **6** | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **VI** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. To transform random variables in to random processes.<br>2. To acquire knowledge about Markov Chain and related processes<br>3. To interpret the steady state solution of the birth and death process in the queueing models.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Define the random process and its classification** | **PSO1** | **K1** |
| **CO2** | **Demonstrate the Markov chain and explain the transition probabilities.** | **PSO1** | **K2** |
| **CO3** | **Construct the Poisson process and develop the relationship with other distributions.** | **PSO2** | **K3** |
| **CO4** | **Dissect process in to birth and death process.** | **PSO3** | **K4** |
| **CO5** | **Interpret the birth and death process in queueing models.** | **PSO4** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Stochastic Processes: Elements of Stochastic Processes – Notion of a Stochastic Process – Specification of Stochastic processes – Stationary Processes. | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Markov Chain: Markov Chains – Definition and examples – Transition probability matrix – Order of a Markov Chain – Higher transition probabilities – Chapman-Kolmogorov equation. | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Poisson Process: Poisson Process– Postulates – Properties – Related distributions – exponential, uniform, geometric and negative binomial distributions. | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | Birth and Death Process: Pure Birth Process – Yule-Fury process – Birth and Death Process – Immigration - Emigration processes. | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Queuing Theory: Basic Elements in a queuing model – Operating Characteristics of queuing models - Classification of queuing models – Poisson Models (M/M/1): (∞/FCFS) and (M/M/1): (N/FCFS) (Steady state solutions only). | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. Medhi, J, Stochastic Processes, (2020) – 5th Edition- New Age International (P) Ltd., Publishers, New Delhi.
2. Kapoor, V. K (2018), Operations Research – Quantitative Techniques for Management, Sultan Chand and Sons, New Delhi.

**References**

1. Bhat,B.R.(2000), Stochastic Models: Analysis and Applications, New Age International Publishers.
2. Sheldon M. Ross , Reprint (2013),Stochastic Processes, Second edition, Wiley Ltd, India.
3. Taha, H., 8th edition (2005), Operations Research: An Introduction, McMillan Publishing company.

**Suggested Reading**

1. Taylor, H. M. and Samuel Karlin (1998). An Introduction to Stochastic modelling, Academic Press, New York.
2. Ross, S. M. (1983). Stochastic Processes, John Wiley and Sons, New York.
3. Durrett, R (2016) Essentials of Stochastic Processes, Third Edition , Springer International Publishing, Switzerland.

4. Hoel, P.G. Port S.C.and Stone, C. J. (1987). Introduction to Stochastic Processes, Waveland Press Inc., U.S.A.
5. Karlin, S and Taylor H. M. (1981). A Second Course in Stochastic Processes, Academic Press, New York.

**Web Resources**

1. https://searchworks.stanford.edu
2. https://www.journals.elsevier.com
3. https://www.routledge.com
4. https://www.researchgate.net
5. https://www.coursera.org
6. https://web.ma.utexas.edu/users/gordanz/notes/introduction_to_stochastic_processes.pdf

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO 1 | - | 3 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO 2 | - | 3 | - | - | - | - | - | - | 3 | - | - | - | - | K2 |
| CO 3 | - | - | - | - | 2 | - | - | - | - | 2 | - | - | - | K3 |
| CO 4 | - | - | - | - | 3 | - | - | - | - | - | 3 | - | - | K4 |
| CO 5 | - | - | - | - | 3 | - | - | - | - | - | - | 3 | - | K5,K6 |
| Wt. Avg. | - | 3 | - | - | 3 | - | - | - | 3 | 2 | 3 | 3 | - | |
| Overall Mapping of the Course | | | | | | | | | | | | PO -3 | | |
| | | | | | | | | | | | | PSO -2.75 | | |

# PROGRAMMING IN PYTHON

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **4** | | |
| **Hours / Cycle** | **6** | | |
| **Category** | **Part-III** | **Core** | **Theory** |
| **Semester** | **VI** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1.To acquire knowledge in core python.<br>2.To know how to compute basic statistics and statistical models through python packages.<br>3. To create own python programs for statistical analysis.** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels(K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **State the basic concepts of Python, features and components related to Python program.** | **PSO1<br>PSO2<br>PSO3** | **K1** |
| **CO2** | **Understand various operators, control statements import export file in Python.** | **PSO1<br>PSO2<br>PSO3** | **K2** |
| **CO3** | **Use various operations, statements functions in Python.** | **PSO2<br>PSO3** | **K3** |
| **CO4** | **Explain various arrays, indexing and visualization in Python.** | **PSO3<br>PSO4** | **K4** |
| **CO5** | **Develop simple statistical programs.** | **PSO3<br>PSO4<br>PSO5** | **K5,K6** |

| SYLLABUS | | | | |
|---|---|---|---|---|
| **UNIT** | **CONTENT** | **HOURS** | **COs** | **BLOOM'S TAXONOMY LEVEL** |
| **I** | Introduction to Python – Origin of Python – Features of Python – Installation of Pythonand its packages – Writing and executing a Python Program. Data types – Build-in data type –Identifier and Reserved words – Name conversions in Python. | **15** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **II** | Operators in Python – Statistical Functions – Input and output statements – ControlStatements – if, if…else and if…elif…else statements – Loops – While – for – infinite – nested.Else Suite – Break – Continue – Pass – Assert – return statements. File Operations – Import andExport of Excel, CSV files | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **III** | Operations in List, Tuples, Dictionary, Set and Frozen Set – String Operations –Functions – Defining and Calling Function – Recursive function – in built functions – DataType conversions – Date and Time. | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **IV** | NumPy arrays – one-dimensional array – Multidimensional arrays – Slicing andaddressing arrays – SciPy – scipy.integrate, scipy.optimize, scipy. interpolate. DataManipulation with Pandas – Data Indexing and Selection, Operating on Data in Pandas,Handling Missing Data, Hierarchal Indexing, Combing Datasets – Visualization with Matplotlib:Simple Line Plots – Simple Scatter Plot – Heat Map – Histograms – Box plot. | **21** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |
| **V** | Measures of central tendency – Measure of dispersion. Parametric testing of Statistical hypothesis – One Sample t test – Two sample t test – paired t test – one way ANOVA- two way ANOVA – Correlation and Regression. | **18** | **CO1**<br>**CO2**<br>**CO3**<br>**CO4**<br>**CO5** | **K1**<br>**K2**<br>**K3**<br>**K4**<br>**K5**<br>**K6** |

**Prescribed Books/Textbooks**

1. NageswaraRao, R, Core Python Programming, 2nd edition, Dreamtech Press, New Delhi (2018).
2. Practical statistics for Data Scientists by Peter Rruce, Andrew Bruce and Peter Gedeck published by Oreilly.

**References**


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


**Suggested Reading**


1. Mark Summerfield, Programming in Python 3, Pearson Education (2009).
2.Python Notes for Professionals – GoalKicker.com


**Web Resources**

1. https://www.youtube.com/c/365DataScience
2. https://www.youtube.com/c/AppliedAICourse
3. https://www.youtube.com/c/DataEngineeringSimplified
4. https://www.youtube.com/c/DataScienceAlivemachine_learning_artificial_tamil
5. https://www.youtube.com/c/Freecodecamp
6. https://www.youtube.com/c/Datacamp
7. https://www.youtube.com/c/Intellipaat
8. https://www.youtube.com/c/khanacademy
9. https://www.youtube.com/user/krishnaik06
10. https://www.youtube.com/c/NeetCode

**Course Articulation Matrix**

| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO 1 | - | 3 | - | 2 | 3 | 2 | 3 | - | 2 | 2 | 3 | - | - | K1 |
| CO 2 | - | 2 | 2 | 2 | 3 | 2 | 3 | - | 2 | 2 | 3 | - | - | K2 |
| CO 3 | - | 2 | - | 2 | 3 | 2 | 3 | - | - | 2 | 3 | - | - | K3 |
| CO 4 | - | - | 2 | 2 | 2 | 2 | 3 | - | - | - | 3 | 2 | - | K4 |
| CO 5 | - | - | 3 | 2 | 2 | 2 | 3 | 2 | - | - | 3 | 2 | 2 | K5,K6 |
| Wt. Avg. | - | 2.3 | 2.3 | 2 | 2.6 | 2.2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO-2.3 | | |
| | | | | | | | | | | | | PSO-2.2 | | |

# MAJOR PRACTICAL-IV

| | | | |
|---|---|---|---|
| **Course Code** | | | |
| **Credits** | **3** | | |
| **Hours / Cycle** | **6** | | |
| **Category** | **Part-III** | **Core** | **Practical** |
| **Semester** | **VI** | | |
| **Year of Implementation** | **From the academic year 2023_2024 onwards** | | |
| **Course Objectives** | **1. In order to provide practical training on the application of Design of Experiments**<br>**2Aiming to provide useful preparation in the application of Statistical Quality Control**<br>**3. Solving real-life problem using Design of Eperiment and Statistical Quality Control** | | |

| **CO** | **Course Outcome(s)** | **PSO Addressed** | **Bloom's Taxonomy Levels (K1 to K6)** |
|---|---|---|---|
| **On completing the course successfully, the student will be able to** | | | |
| **CO1** | **Define the foundation of Design of Experiment and Statistical Quality Control** | **PSO1** | **K1** |
| **CO2** | **Comprehend the elementary ideas of Design of Experiment and Statistical Quality Control** | **PSO2** | **K2** |
| **CO3** | **Select the right statistical tool for the given data** | **PSO3** | **K3** |
| **CO4** | **Relate the statistical tools in practical application** | **PSO4** | **K4** |
| **CO5** | **Assess the interpretation of practical application** | **PSO4**<br>**PSO5** | **K5, K6** |

**EXCERICES**

**Design of Experiments**

1. One way Classification (Equal size)
2. One way Classification (Unequal size)
3. Two Way Classification (One Observation Per Cell)
4. Two Way Classification (m Observation Per Cell)
5. Completely Randomized design (CRD) with Equal Replications
6. Completely Randomized design (CRD) with Unequal Replications
7. Randomized Block Design (RBD) without interaction
8. Randomized Block Design (RBD) with interaction
9. Randomized Block Design with one missing value
10. Randomized Block Design with two missing value
11. Latin Square Design
12. Latin Square Design with one missing value
13. $2^2$ Factorial Experiment
14. $2^3$ Factorial Experiment
15. Total Confounding in $2^3$ Factorial Experiment
16. Partial Confounding in $2^3$ Factorial Experiment
17. $3^2$ Factorial Experiment
18. Balanced Incomplete Block Design

**Statistical Quality Control**

1. $\bar{X}$ chart and R chart (Two Problems)
2. $\bar{X}$ chart and S chart (Two Problems)
3. p chart (Fixed sample size)
4. p chart (Variable sample size)
5. np chart
6. c chart
7. u chart
8. Single Sampling plan for attributes
9. Single Sampling plan for attributes (varying acceptance number)
10. Double Sampling plan for attributes

| Course Articulation Matrix | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course Outcomes | Programme Outcomes | | | | | | | | Programme Specific Outcomes | | | | | Cognitive Level |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | |
| CO 1 | - | 3 | - | - | - | - | - | - | 3 | - | - | - | - | K1 |
| CO 2 | - | 1 | - | - | 1 | 2 | 2 | - | - | 3 | - | - | - | K2 |
| CO 3 | - | - | - | 2 | 3 | - | 2 | - | - | - | 3 | - | - | K3 |
| CO 4 | - | - | 2 | - | - | 2 | 2 | - | - | - | - | 3 | | K4 |
| CO 5 | - | - | 2 | - | - | 2 | 2 | 2 | - | - | - | 2 | 2 | K5, K6 |
| Wt. Avg. | - | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2.5 | 2 | |
| Overall Mapping of the Course | | | | | | | | | | | | PO- 2<br>PSO- 2.7 | | |

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