P.G. AND RESEARCH
DEPARTMENT OF STATISTICS

PERIYAR E.V.R. COLLEGE (AUTONOMOUS)
TIRUCHIRAPPALLI – 620 023.

SYLLABI

M.Sc. STATISTICS

MCBCS

(from 2015 onwards)

Question Paper Pattern

For all Core courses the Question Pattern is as follows.

Section - A   (10 x 2 = 20)
Answer ALL the questions

Two questions from each unit of the syllabus.

Section - B   (5 x 5 = 25)
Answer ALL the questions

Five questions in either or pattern with internal choice covering all the five units of the syllabus

Section - C (3 x 10 = 30)
Answer any THREE questions

Five questions covering all the five units of the syllabus

MCBCS – COURSE STRUCTURE M.Sc STATISTICS (2015 – 2016)

SL. No.			COURSE TITLE	Hrs.	Credits	Internal Exam	External Exam
			I - SEMESTER				
1	-	CORE - I	DISTRIBUTION THEORY	6	5	25	75
2	-	CORE - II	ADVANCED OPERATIONS RESEARCH	6	5	25	75
3	-	CORE - III	SAMPLING THEORY	6	4	25	75
4	-	CORE - IV	MEASURE THEORY AND PROBABILITY	6	4	25	75
5	-	CORE - PV	PRACTICAL (O.R, SAMPLING & DISTRIBUTIONS)	6	4	25	75
			TOTAL	**30**	**22**	**125**	**375**
			II - SEMESTER				
6	-	CORE - VI	REGRESSION ANALYSIS	6	5	25	75
7	-	CORE - VII	LINEAR MODELS AND DESIGN OF EXPERIMENTS	6	5	25	75
8	-	CORE - VIII	RELIABILITY & STATISTICAL DECISION MAKING	6	5	25	75
9	-	CORE- IX	REAL ANALYSIS AND MATRICES	6	4	25	75
10	-	CORE- P X	PRACTICAL (REGRESSION, MATRIX & DESIGN OF EXPERIMENTS)	6	4	25	75
			TOTAL	**30**	**23**	**125**	**375**
			III – SEMESTER				
11	-	CORE - XI	STATISTICAL INFERENCE-I	6	5	25	75
12	-	CORE -XII	APLLIED MULTIVARIATE ANALYSIS	6	5	25	75
13	-	CORE - P III	PRACTICAL (MULTIVARIATE, QUALITY ASSURANCE AND POPULATION STATISTICS)	6	5	25	75
14	-	CBE - I	POPULATION STATISTICS	6	4	25	75
15	-	CBE - II	QUALITY ASSURANCE	6	4	25	75
			TOTAL	**30**	**23**	**125**	**375**
			IV – SEMESTER				
16	-	CORE - XIV	STATISTICAL INFERENCE-II	6	5	25	75
17	-	CORE- P XV	COMPUTER LAB FOR STATISTICAL ANALYSIS	6	5	25	75
18	-	CBE - III	STOCHASTIC PROCESS	6	4	25	75
19	-	CBE - IV	JAVA PROGRAMMING	6	4	25	75
20	-	PROJECT	PROJECT	6	4	25	75
			TOTAL	**30**	**22**	**125**	**375**
			GENERAL TOTAL	**120**	**90**	**500**	**1500**

CORE – I

DISTRIBUTION THEORY

Semester - I   **Hours : 6**

Code :   **Credit : 5**

Objective : To create awareness about important discrete and continuous distributions.

Unit – I

Discrete Distributions - Binomial, Poisson and Geometric distributions – Derivation of the distributions and their constants, properties and problems.

Unit – II

Continuous Distributions - Normal, Laplace, Exponential, Erlang, Weibull and Cauchy distributions – Derivation of the distributions and their constants, properties and problems.

Unit – III

Bivariate Normal distribution – derivation of its Moment Generating Function, marginal and conditional distributions.

Unit – IV

Student's - t , Chi-square, and Snecdecor's F distributions – Derivations of the distributions, properties and relationship between 't' , F and Chi-square distributions.

Unit – V

Order Statistics: Distribution of smallest, largest, and r^{th} order Statistics - Distribution of Range and median - Joint distribution of two order statistics and Joint distribution of several order statistics.

Text Book:

Gupta.S.C. and Kapoor V.K.- Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

Books for Reference:

1. Rohatgi. V.K., An Introduction to Probability theory and Mathematical Statistics. Wiley Eastern.
2. John and Kotz, Discrete distribution, John Wiley Publications, New York.
3. John and Kotz, Continuous distribution, John Wiley Publications, New York.

CORE - II

ADVANCED OPERATIONS RESEARCH

Semester – I   Hours : 6

Code: Credits : 5

Objective: To impart knowledge on the various advanced topics of Operations Research and their usage in real life.

Unit - I

Linear Progarmming Problem(LPP) - Graphical Method, Algebraic solutions, Simplex method, Two-Phase Simplex, Duality in Linear Programing, Dual Simplex Method and Revised Simplex Method.

Unit - II

Non-Linear Programming Problem(NLPP) - Formulating a non-linear programming problem, Kuhn-Tucker conditions for non-linear programming. Quadratic Programming - Wolfe's method and Beale's method.

Unit - III

Integer Programming - Gomory's fractional cut method for all integer, fractional cut method for mixed integer and Branch and Bound method.

Unit - IV

Inventory control - Deterministic inventory problems with no shortages and with shortages. Project Scheduling by PERT and CPM – Network, Critical Path Method and PERT Calculations.

Unit - V

Game Theory – Introduction, Optimal solution of Two-Person Zero Sum Games, Rules for determining a Saddle Point, Graphical Solution of 2 x n and m x 2 games, General solution of m x n Rectangular games-Algebraic method.

Text Book:

   Kanti Swarup, P.K Gupta and Man Mohan, Operations Research, Sultan Chand, New Delhi.

Books for Reference:

1. Hamdy A.Taha, An Introduction to Operations Research, Prentice Hall of India, New Delhi.
2. Ravindran.A, Don.T.Phillips and James J.Solberg, Operations Research Principles and Practice, John Wiley & Sons.
3. Pannerselvam.R., Operations Research, Prentice Hall of India, New Delhi.
4. Prem Kumar Gupta, Hira. D.S., Operations Research, S.Chand & Company Ltd, New Delhi.

CORE - III

SAMPLING THEORY

Semester – I   **Hours : 6**

Code: **Credits : 4**

Objective: To study the various Sampling techniques and apply them practically.

Unit – I

Simple Random Sampling - procedure of selecting a random sample, estimation of population parameters, estimation of population proportions, combination of unbiased estimators, Confidence Limits and Estimation of sample size.

Unit – II

Stratified Random Sampling - Introduction, principles of stratification, advantages of stratification, notations, estimation of population mean and its variance, estimation of variance, allocation of sample size in different strata, Relative precision of Stratified Random Sampling with Simple Random Sampling.

Unit- III

Systematic Random Sampling - Introduction, sample selection procedures, advantages and disadvantages, estimation of mean and its sampling variance, comparison of systematic with random sampling, comparison of Systematic Sampling with Stratified random Sampling and Estimation of variance.

Unit - IV

Cluster Sampling - Introduction, Notations, Equal Cluster Sampling, Estimator of Means and its Variance, Relative efficiency of Cluster Sampling and Optimum Cluster size.

Multi Stage Sampling - Sampling procedure, Two-Stage Sampling with equal first-stage units, estimation of mean and its variance, Two-Stage Sampling with unequal first-stage Units and Estimators of Mean and their Variances.

UNIT – V

Multiphase Sampling – Introduction, Double Sampling for Stratification, Optimal Allocation, Double Sampling for difference estimator, Double Sampling for Ratio Estimator and Double Sampling for Regression Estimator.

Text Book:

Daroga Singh and F.S.Chaudhary, Theory and analysis of Sampling Survey Design, New Age International (P) Ltd., Chennai.

Book for Reference:

Cochran W.G. (1984), Sampling Techniques, Wiley Eastern Ltd.

CORE – IV

MEASURE AND PROBABILITY THEORY

Semester – I   **Hours : 6**

Code :   **Credits : 4**

Objective: To impart the knowledge to the post-graduate students about the applications of measure theory and probability in the field of statistics.

Unit – I

Events and Classes – Algebra of Set – Sequence, Limits. Field – Minimum Field, σ-field, and Borel Field. Intersection and Union of Fields, Monotone Fields and necessary properties. Minimum Monotone classes

Unit – II

Functions and Inverse Functions, Measurable Function, Borel Function, Induced σ-field, Indicator Functions, Simple Function and Random Variables (Concept only).

Unit – III

Distribution Function – Properties, Jordan Decomposition Theorem, Distribution Function of a Random Vector, Marginal and Conditional Distributions. Inequality – Cramer Inequality, Schewartz Inequality and Jenson's Inequality.

Unit – IV

Convergence of Random Variables - Types of Convergence, Monotone Convergence Theorem, Dominated Convergence Theorem. Characteristic Function – Properties, Inversion Theorem and simple problems.

Unit – V

Law of Large Numbers - Weak and Strong Law of Large Numbers, Bernoulli's Weak Law of Large Numbers, Khintchine's Weak Law of Large Numbers, Kolmogorov's Strong Law of Large Numbers. Central Limit Theorem - Lindeberg–Levy's, Liaponov's form and Lindberg – Feller Central Limit Theorem (Statement only).

Text Book:

Bhat, B. R. (2014) , Modern Probability Theory-An Introductory Text Book, Third Edition, New Age International.

Book for Reference:

Rohatgi V.K.(2002) : Introduction to Mathematical Statistics, Wiley.

PRACTICAL

Semester – I   **Hours : 6**

Code :   **Credits: 4**

Objective: **To develop the computational skills in Distribution, Sampling and Operations Research.**

Unit – I

Fitting of Binomial, Poisson and Normal Distributions.

Unit - II

Estimation of Mean and Variance of the population and variance of the estimator of the mean using Simple Random Sampling and Stratified random sampling with proportional allocation and optimum allocation.

Unit - III

Estimation of mean and variance of population using Systematic Random sampling. Estimation of mean and variance of population using cluster sampling, multi-stage and multiphase sampling.

Unit - IV

Linear Programming Problem(LPP): Two-Phase Simplex, Duality and Dual Simplex Method. Revised Simplex Method.

Unit - V

Integer Programming - Gomory's fractional cut method for all integer and fractional cut method for mixed integer, Branch and Bound method.

Text Books:

1. . Gupta,S.P. & Kapoor,V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. Daroga Singh and F.S.Chaudhary, Theory and analysis of Sampling Survey Design, New Age International (P) Ltd., Chennai.
3. Kanti Swarup, P.K Gupta and Man Mohan, Operations Research, Sultan Chand, New Delhi.

CORE - VI

REGRESSION ANALYSIS

Semester - II   **Hours : 6**

Code: **Credits : 5**

Objective : To understand the practical applications of the various regression models and Time series.

Unit - I

Simple linear Regression model - Least square estimation of the parameters- Estimation of β_0 and β_1- properties of the least square estimators - Estimation of σ^2- Hypothesis testing on the slope and intercept. Estimation by Maximum likelihood method - Interval estimation in simple linear regression: Confidence Intervals on β_0, β_1 and σ^2.

Unit - II

Multiple linear Regression models - Estimation of model parameters-Least Square estimation of the Regression co.efficients-Properties of least square estimators- Estimation of σ^2 – Maximum Likelihood Estimation - Hypothesis testing in multiple linear regression, confidence interval in multiple regression co.efficients.

Unit - III

Multicollinearity - Sources of multicollinearity - methods for dealing with multicollinearity - Ridge Regression – Specification bias.

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Unit - IV

Generalized and weighted least squares-Robust regression - Properties of Robust estimators - Non-linear regression models - Generalized linear models- Logistic regression model - Link function and linear predictors

Unit - V

Validation of Regression Models – validation techniques, analysis of model coefficient and predicted values, collecting fresh data- confirmation runs, data splitting and data from planned experiments.

Text Book:

Douglas C. Montgomery and Elizabeth A.Peck-Introduction to linear Regression Analysis-John Whiley &Sons, New York.

CORE – VII

LINEAR MODEL AND DESIGN OF EXPERIMENTS

Semester – II   **Hours : 6**

Code :   **Credits : 5**

Objective: To gain knowledge in the field of Design of Experiments.

Unit – I

Linear Models: Definition – Functionally Related Models – Mean Related Model – Regression Model – Experimental Design Model – Components of Variance Model – Point Estimation – Estimation of β and σ^2 under normal theory – Gauss Markoff theorem

Unit – II

RBD - Missing observations in RBD – Analysis of RBD with one and two missing values – Analysis of LSD with one and two missing values – Orthogonal Latin Squares – Graeco LSD

Unit –III

Factorial Experiment: Main effects, Interaction effects, orthogonal, contrasts – Designs for 2^n, 3^n experiments. Total and Partial confounding in 2^3 experiments – Analysis of Split Plot Design.

Unit – IV

Incomplete Block Design – Balanced Incomplete Block Design – Relationship between the parameters. Constructions of BIBD – Recovery of Inter Block Information – Resolvable Designs

Unit –V

Analysis of PBIBD - Two Associate classes and Response surface design.

Text Books:
1. Graybill,F.A.: An Introduction to Linear Statistical Models, McGraw Hill, NewYork.
2. Das, M.N. and Giri, N.C, (1997), Design and analysis of experiments, Wiley Eastern Ltd., New Delhi.

Books for Reference:
1. Joshi,D.D. Linear Estimations and Design and analysis of experiments, Wiley Eastern ltd., New Delhi.
2. Aloke Day: Theory of Block Design, Wiley Eastern Ltd., New Delhi.

CORE - VIII

RELIABILITY AND STATISTICAL DECISION MAKING

Semester - II   **Hours : 6**

Code :   **Credit : 5**

Objective : To enable the students to decide on choosing the best course of action out of several alternatives.

Unit – I

Reliability – Definition, basic elements of reliability, Failure pattern for complex product, Designing for Reliability, Methods for Improving Design Reliability and Measurement of reliability.

Unit – II

Maintenance and Reliability – Mean Time Between Failures, Failure Rate and Hazard Function – Constant Hazard Model, Linear-hazard model, Mean Time to Failure. System Reliability – Components connected in series and Components connected in parallel (Concepts only).

Unit – III

Meaning, Scope and elements of decision making problems. Meaning of Pay off, Payoff table and Opportunity Loss or Reject Table.

Types of decision making situations: Under Certainty, Under Uncertainty, Under Condition of Risk and Under Perfect Information – problems.

Unit – IV

Expected Monetary value, Expected Opportunity Loss, Expected value of perfect information, working rule and problems. Bayesian Decision Theory – Baye's Theorem of Inverse probability and simple problems.

Unit – V

Decision Tree Analysis - Steps and Advantages and Limitations of Decision Theory.

Text Books:

1. M.Mahajan, Statistical Quality Control, (2009), Dhanpat Rai & Co.(Unit – I and II)
2. Arora, P.N., Sumeet Arora and Arora, S., Comprehensive Statistical Methods,
   S.Chand and Company Ltd. New Delhi. (Unit – III to V).

Book for Reference:

   T.Veerarajan, Probability, Statistics and Random Processes, Tata McGraw-Hill,
   New Delhi.

CORE - IX

REAL ANALYSIS AND MATRIX THEORY

Semester - II   **Hours : 6**

Code: **Credit : 4**

Objective: To improve the mathematical skills among the post-graduate students

Unit - I

Functions - Real valued function, Equivalence, countability, least upper bounds Sequence of real numbers-Definition, limit of a sequence, convergent sequence, divergent sequence, bounded sequence, monotone sequence, limit superior and limit inferior, Series of real numbers - convergence and divergence, series with non-negative terms, alternating series, conditional convergence and absolute convergence.

Unit - II

Calculus - Sets of measure zero, Definition of the Riemann integral, existence of the Riemann integral, Derivatives, Rolle's Theorem, the law of the mean, Fundamental theorems of calculus, improper integrals.

Unit - III

Rank of a matrix – elementary transformation of a matrix, Equivalent Matrices, Elementary matrices, Echelon Matrix – Hermite Canonical form, Sylvester's law, Frobenius inequality, certain results on the rank of an Idempotent matrix.

Unit -IV

Eigen values and Eigen vectors - properties, Cayley-Hamilton theorem, application of Cayley-Hamilton theorem - simple problems.

Unit - V

Generalized inverse of a matrix: definition, different classes of generalized inverse, properties of G-inverse - classes properties - properties of Moore and Penrose – application of Generalized inverse in the solution of system of linear equations. Quadratic forms - Definition, classification of the quadratic form, positive semi-definite quadratic form and Canonical reduction.

<u>**Text Books:**</u>

1. Goldberg. R. (1963), Method of Real Analysis, Oxford & IBH publishers, New Delhi. (unit-I: Chapter –I :Page no.3-17,21-75, Unit-II:Chapter-7:Page no.156-194).
2. Biswas.S(1996), A Text book of Matrix Algebra, New Age International Publishers, NewDelhi.(Unit-III :Chapter-5,Unit-IV:Chapter-7:page no.185-198,208-209,213-227. Unit-V:Chapter-8: page no.228-245 and Chapter-9: page no.267-268,317-323).

<u>**Books for Reference:**</u>

1. Walter Rudin(2006), Real and Complex Analysis, Third Edition, Tata McGraw Hill.
2. Singal M.K. Asha Rani Singal , A First Course in Real Analysis, chand and Co, New Delhi.
3. Shanthi Narayanan(2009), A Text book of matrices, S.Chand & Co, New Delhi.

CORE - P X

PRACTICAL

Semester – II   **Hours : 6**

Code :   **Credits: 4**

Objective: To explore the applications of Statistical concepts

Unit - I

Multiple Correlation Coefficient – Coefficient of Partial Correlation – Multiple Regression Equation (Three Variables only).

Unit – II

Generalized and weighted least squares-Robust regression - Generalized Logistic regression model.

Unit - III

Eigen values and Eigen vectors - application of Cayley-Hamilton theorem - Generalized inverse of a matrix

Unit - IV

Analysis of RBD with one and two missing values, Analysis of LSD with one and two missing values.

Unit - V

Analysis of 2^3 and 3^2 factorial experiments, Total and Partial Confounding in 2^3 factorial experiments. Analysis of BIBD and Analysis of PBIBD.

Text Books:

1. Gupta,S.P. & Kapoor,V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi
2. Biswas.S(1996), A Text book of Matrix Algebra, New Age International Publishers, NewDelhi

CORE – XI

STATISTICAL INFERENCE - I

Semester - III   Hours : 6

Code :   Credit : 5

Objective : To focus on the importance of the estimation theory

Unit – I

Point Estimation – properties of estimators. Consistency and efficiency of an estimator. Sufficiency of a statistic. Simple problem.

Unit – II

Unbiasedness – properties, minimum variance unbiased estimators, Rao-Blackwell theorem. Sufficiency and completeness, Lehman -Scheffe's Theorem, Cramer – Rao Inequality- simple problems.

UNIT – III

Methods of Estimation: Maximum Likelihood Estimation method – Asymptotic properties of MLE. simple problems.

UNIT – IV

Interval Estimation - confidence level and confidence co- efficient, Confidence interval for single proportion, difference between proportions, single mean and difference between proportions – simple problems.

UNIT – V

Construction of Confidence intervals for variance based on chi square, Student's- t, and F distributions. simple problems

Text Books:
1. Rohatgi.V.L, "An introduction to probability theory and Mathematical Statistics", Wiley Eastern limited.
2. Gupta.S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

Book for Reference:

  C. Radhakrishna Rao, "Linear Statistical Inference and its Applications", Wiley Eastern limited

CORE - XII

APPLIED MULTIVARIATE ANALYSIS

Semester – III   **Hours : 6**

Code :   **Credits : 5**

Objective: **To train the students to acquire theoretical background of Multivariate Statistical Tools and apply them in real life situation**.

Unit – I

Aspects of Multivariate Analysis – Some basics of matrix and vector algebra – mean vectors and covariance matrices – Generalised variance – Multivariate normal distribution – multivariate normal density and its properties.

Unit – II

Hotelling T^2 Statistic: Introduction – derivation and its distributions – Uses of T^2 statistic – Properties of the T^2 test. Wishart distribution - Definition and properties only.

Unit – III

Principal components: Introduction – population principal components – summering sample variation by principal components – Graphing the principal components.

Unit – IV

Factor analysis and inference for structured covariance matrices: Orthogonal factor model – methods of estimation – Factor rotation – Factor scores.

Unit – V

Discrimination and classification - Separation and classification for two populations – Classification with two multivariate normal populations – Evaluating classification functions – Fisher's discriminant function – Fisher's method for discriminating among several populations.

Text book:
Richard A.Johnson and Dean W.Wichern (2003): Applied multivariate statistical analysis, Third Edition, Prentice – Hall of India Private Ltd, New Delhi.

Book for Refernce:
Anderson T.W. (1957): An introduction to multivariate statistical analysis, Wiley Eastern Private Limited, New Delhi.

CORE - P XIII

PRACTICAL

Semester – III   Hours: 6

Code: Credits: 5

Objective: To learn to solve problems in Multivariate Analysis, Quality Assurance and vital statistics.

Unit - I

Hotelling T^2 – Principal Component Analysis – Factor Analysis – Cluster Analysis.

Unit - II

Process Capability Analysis (PCA) using Histogram - PCA using a Control Chart, PCA using Designed experiments - Cumulative Sum Control Chart.

Unit - III

Exponentially Weighted Moving Average Control Chart – Moving Average Control Chart – Modified and Acceptance Control Charts – Group Control Charts.

Unit – IV

Calculation of Crude and Standardized Death Rates (Direct and Indirect Method)

Unit - V

Calculation of Genral Fertility Rate, Specific Fertility Rate, Total Fertility Rate, Gross Reproduction Rate and Net Reproduction Rate.

Text books:
1. Anderson T.W. (1957): An introduction to multivariate statistical analysis, Wiley Eastern Private Limited, New Delhi.
2. Douglas C. Montogomery (2013), Statistical Quality Control. A modern Introduction, John Wiley, 6th Edn..
3. Gupta,S.P. & Kapoor,V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi

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CORE BASED ELECTIVE - I

POPULATION STATISTICS

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Semester – III   **Hours : 6**

Code :   **Credits : 4**

**Objective: To enable the students to have an idea about Vital Statistics and
            Demography**

Unit – I

Definition of vital statistics and demography – concepts on population and measurement of population, uses of vital statistics, sources of collecting Vital Statistics, parts of demography,

Unit – II

Concepts and definitions of Sex Ratio, Rate of a Vital Event, Cohort, Generation, Marriages, Divorce, Separation, Stable Population, Stationary Population, Fertility and Mortality. Birth Rates – Crude Birth Rate, General Fertility Rate, Specific Fertility Rate and Total Fertility Rate (only concepts and formulae).

Unit – III

Measurement of Mortality – Crude Death Rate, Specific Death Rate, Infant Mortality Rate, Standardized Death Rates – Direct and Indirect method of standardization (No problems), Central Mortality Rate and Force of Mortality.

Unit – IV

Life Table – Assumptions, Descriptions, Construction and Uses of Life Table. Definitions of l_x, d_x, $_np_x$, p_x, q_x, L_x and e_{0x}. Expectation of life – Curate expectation and complete expectation of life. Basic theorems with proof.

Unit – V

Reproduction Rates – Gross Reproduction Rates and Net Reproduction Rates – Graduation of Mortality Rates – Makehem's Graduation Formula, Gompertz Makehem formula for Mortality, Method of four selected points and Method of partial sums.

Text Books:

1. Gupta,S.P. & Kapoor,V.K., Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi. (Unit I to Unit V)
2. Peter R Cox, Demography, Fifth edition, Vikas Publishing House, New Delhi. (Unit I and Unit II)

Book for Reference:

Hansraj, Fundamentals of Demography, Surjeet Publications, New Delhi

CORE BASED ELECTIVE – II

QUALITY ASSURANCE

Semester - III   **Hours : 6**
Code :   **Credit : 4**

Objective: To create the consciousness about the standards of quality.

Unit – I

Quality – Quality Improvement – Dimensions of Quality – Quality Engineering terminology – Statistical methods for Quality Control and Improvement – Management aspects of Quality Improvement: Quality Planning, Quality assurance, Quality control and improvement, Quality Philosophy and Management Strategies: Deming's 14 points, Total Quality Management, Quality Systems and Standards – Quality Costs.

Unit – II

Basic concepts of Six Sigma and Lean Six Sigma – DMAIC Problem solving process: Define step, Measure step, Analyse step, Improve step, Control step – Examples of DMAIC: Litigation documents, Improving on time delivery, Improving service quality in a Bank.

Unit-III

Statistical Process Control: Chance and assignable causes of Quality Variation – Statistical basis of the control charts – Average run length – Average time to signal – Rational subgroup – Analysis of patterns on control charts – Rest of the magnificent seven – Implementing SPC in a Quality Improvement Program.

Unit – IV

Process Capability Analysis(PCA) – PCA using Histogram or a probability plot – Process Capability Ratios (PCR) – PCR for an Off-Center Process – Normality and the PCR – Confidence intervals and tests on PCR – PCA using a Control Chart, PCA using Designed experiments – PCA with attribute data.

Unit – V

Cumulative Sum Control Chart: V Mask Procedure – Exponentially Weighted Moving Average Control Chart – Moving Average Control Chart – Modified and Acceptance Control Charts – Group Control Charts.

<u>**Text Book :**</u>
Douglas C. Montogomery (2013), Statistical Quality Control. A Modern Introduction, John Wiley, 6th Edn..

<u>**Books for Reference:**</u>
Juran(1998) , Quality Control Handbook, McGraw Hill, 4th Edn.
Mahajan(1997), Statistical Quality Control, Dhanpath Rai & Sons.

CORE - XIV

STATISTICAL INFERENCE - II

Semester – IV   **Hour   : 6**

Code :   **Credits : 5**

Objective: To get an in depth knowledge about testing of hypothesis.

Unit – I

Statistical Hypothesis – Simple and Composite, Null and Alternative Hypothesis. Concept on Critical Region, Types of errors, Level of Significance, Power of a test. Optimum tests – Most Powerful Test(MPT), Uniformly Most Powerful Test(UMPT) and Neyman-Pearson Lemma - simple problems.

Unit – II

Likelihood Ratio Test - Definition and properties - Likelihood ratio test for a mean of a normal population, equality of means of two normal population, variance of normal population, equality of variances of two normal populations.

Unit – III

Hyphothesis testing – Prior and Posterior odds, Base factor for simple vs simple hypothesis, Base factor for composite vs composite hypothesis. Lindley's procedure for test of significance, Lindley's paradox and Decision Theoretic Approach to testing problems.

Unit – IV

Sequential Analysis - Wald's Sequential Probability Ratio Test, properties, efficiency and Fundamental Identity of Sequential Analysis.

Unit - V

Non – parametric tests - Advantages and Disadvantages – Sign test, Median test, test for randomness, Wald–Wolfowitz run test, Kolmogrow–Smirnov (one and two samples) tests and Mann Whitney Wilcoxon U-test.

<u>**Text books:**</u>

1. Gupta S.C. and Kapoor V.K. (1993), Fundamental of Mathematical Statistics, Sultan Chand & Sons, New Delhi (Unit I, Unit II and Unit V).

2. Radhakrishna Rao C., Linear Statistical Inference and its Applications – Second Edition, Wiley Eastern Limited (Unit IV).

3. Leonard T. and Hsu.JSJ,Bayesian Methods, Cambridge University Press (Unit III).

<u>**Books for Reference:**</u>

1. Rohatgi. V and Saleh (2002), Statistical Inference, Asia Publications

2. Lehmann.E.L, Testing of Statistical Hypothesis, John Wiley.

3..Gibbons.J.D , Non – Parametric Statistical Inference, Duxbury.

4. Berger J.O, Statistical Decision Theory and Bayesian Analysis, Sriges Verlog.

COMPUTER LAB FOR STATISTICAL ANALYSIS

Semester – IV   **Hours : 6**

Code: **Credits: 5**

Objective : To know how to apply statistical tools using computers.

Unit – I

Diagrammatic and Graphical representation of data. Formation of Uni-variate frequency distribution, Calculating the measures of central tendency, dispersion, skewness and kurtosis.

Unit – II

Calculating Karl-Pearson's co.efficient of Correlation, Spearman's Rank Correlation, Simple Regression analysis.

Unit – III

Calculation of Partial and multiple correlation co.efficients, Multiple regression equations, Discriminant analysis, Principle component analysis.

Unit – IV

Applications of Student's t tests, F tests, and Normal tests. Analysis of Variance.

Unit - V

Chi-Square tests, Mann-Whitney U test, Wilcoxon Signed Rank test and Kruskal-Wallis test.

Text Book:

Ajai J Gaur and Sanjaya S. Gaur (2008), Statistical Methods for Practice and Research A guide to data analysis using SPSS, First Edition, Sage Publications.

CORE BASED ELECTIVE – III
STOCHASTIC PROCESSES

Semester: IV   **Hours : 6**

Code :   **Credit : 4**

Objective: To study the importance of the stochastic processes and its applications.

Unit – I

Stochastic Processes: Definition and examples: Classification of Stochastic Processes. Markov Chains - Definition and examples: one and two dimensional random walk; Transition probabilities; Classification of States and chains.

Unit – II

Basic limit theorems of Markov Chains, determination of higher transition probabilities. Stability of a Markov system- limiting behavior : finite irreducible chain, computation of the stationary probabilities, examples.

Unit – III

Continuous time Markov Chains - Poisson Process - its derivation and properties. Pure birth processes : Yule furry process. Birth and death processes.

Unit – IV

Renewal processes – renewal function, renewal equation, stopping time : Wald's equation, renewal theorems. Branching process - generating function relation, mean and variance of generations.

Unit – V

Queueing processes - general description of M/M/I models with finite and infinite Capacities, Waiting time and busy period for both steady state and transient state behavior. Birth and Death processes in queuing theory. Multi-channel model M\M\S. Non-Markovian Queues model (concept only).

Text Book:
Medhi. J. (2010), Stochastic Processes, New age international(p) limited publishers, NewDelhi.

Books for Reference:
1. Karlin, S. and Taylor. H.W (1975), A First Course in Stochastic Processes, Academic Press, 2nd Edn.
2. Karlin S. and Taylor. H.W (1979), A Second course in Stochastic Processes, Academic Press.
3. Basu A.K(2007), Introduction to Stochastic Processes, Narosa Publishing.
4. Srinivasan, S.K. .(1976), Introduction to Stochastic processes and their Applicatiions,Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

CORE BASED ELECTIVE - IV

JAVA PROGRAMMING

Semester – IV   **Hours : 6**

Code: **Credits : 4**

Objective: **To develop the students in programming in JAVA language.**

Unit – I

Principles of Object Oriented Programming - Software evolution - Basic concepts of OOP, Features of OOP and Applications of OOP - Java Programming structure – Constants, Variables, Data types and Type Conversion.

Unit – II

Operators - arithmetic operators, relational operators, logical operators, assignment operators, conditional operators, bitwise operators and special operators. Arithmetic expression - evaluation of expression - if, switch, while, do and for statements.

Unit – III

Class – Objects – Methods – Inheritance – Arrays – Strings – Interfaces – Packages -exception handing.

Unit – IV

Applet - Introduction, building applet code, Designing a web page, Applet tag, Applet to HTML file, Graphics class-lines & rectangles -Drawing bar charts.

Unit – V

Java programming - Using class and objects - sum of the series, mean and SD, sum of the digits, sorting strings, Fibonacci series and correlation coefficient.

Text book:

Balagurusamy.E., Tata McGRAW HILL.(2001)- Programming with Java A Primer, 2nd Edition

Books for Reference:

1. Muthu.C,(2001): Programming with JAVA- Thomson Asia Pvt. Ltd, Singapore
2. Patrick Naughton &Herbert Schildt, (1999) The Complete Reference Java, Tata
    McGRAW HILL.