P.G AND RESEARCH
DEPARTMENT OF STATISTICS
PERIYAR E.V.R. COLLEGE (AUTONOMOUS)
TIRUCHIRAPPALLI – 620 023.

SYLLABI

M.STAT

From 2018-19 onwards
Question Paper Pattern

For all Core courses the Question Pattern is as follows.

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

Two questions from each unit of the syllabus.

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

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

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

Five questions covering all the five units of the syllabus.
# COURSE STRUCTURE FOR M.STAT (2018 – 2019 Onwards)

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>COURSE TITLE</th>
<th>Hrs.</th>
<th>Credits</th>
<th>Internal Exam</th>
<th>External Exam</th>
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<td>CORE - III DISTRIBUTION THEORY</td>
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<td>5</td>
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<td>8</td>
<td>CORE - VIII REGRESSION ANALYSIS &amp; TIME SERIES</td>
<td>6</td>
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<td>CORE- P XV COMPUTATIONAL STATISTICS(BASED ON SAMPLING, DESIGN &amp; TEST OF HYPOTHESIS)</td>
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<td>CBE - III LINEAR MODELS AND DESIGN OF EXPERIMENTS</td>
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CORE BASED ELECTIVE COURSES

1. SURVIVAL ANALYSIS
2. ACTUARIAL STATISTICS
3. LINEAR MODELS AND DESIGN OF EXPERIMENTS
4. QUALITY ASSURENCE
5. INTRODUCTION TO PYTHON
6. SIMULATION MODELING
7. DISCRETE MATHAMETICS
8. STATISTICAL DATA ANALYSIS USING SAS
9. DATA MINING
CORE - I

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 Programming Problem (LPP) - Graphical Method, Algebraic solutions, Simplex method, Two-Phase Simplex, Duality in Linear Programming, Dual Simplex Method.

Unit – II

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

Unit - III

Goal Programming – Formulation of Linear Goal Programming Problem, Graphical method, Simplex method for Goal Programming Problem. Revised Simplex Method

Unit – IV

Dynamic Programming - Principle of optimality, the Recursive Equation Approach, Characteristics of Dynamic Programming Problem(DPP), Algorithm of DPP, Solution of Discrete DPP, Solution of LPP by DPP

Unit – V

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.

Book for Study:


Books for Reference:

CORE - II

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.


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.

Books for Study:
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:
CORE-III
DISTRIBUTION THEORY

Semester – I              Hours   : 6
Code:                                            Credits: 4

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, Weibul 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 S necdecor’s F distributions – Derivation of the distributions, properties and relationship between ‘t’, F and Chi-square distributions.

Unit-V

Book for Study:

Books for Reference:
CORE – IV

MEASURE AND PROBABILITY THEORY

Semester – I                                 Hours : 6
Code :                                Credits : 4

Objective: To impart the knowledge about the applications of measure theory and probability.

Unit – I

Events and Classes – Algebra of Set – Sequence, Limits. Field – Minimum Field, \( \sigma \)-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 \( \sigma \)-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 Holder Inequality.

Unit – IV


Unit – V


Books for Study:

3. Feller.W. (1968) Introduction to Probability and Application,

Books for Reference:

CORE – PV
COMPUTER LAB FOR R PROGRAMMING

Semester – I                          Hours : 6
Code :                                Credits : 4
Objectives: To train students in R Software

List of Topics:
Diagrammatic and Graphical Representation:
1. Simple Bar Diagram
2. Multiple Bar Diagram
3. Line Diagram
4. Pie Diagram
5. Histogram and Frequency Curve
6. Box Plot
7. Scatter Diagram
Frequency Distribution table

Measures of Central Tendency:
1. Arithmetic Mean
2. Median
3. Mode
4. Geometric Mean
5. Harmonic Mean

Measures of Dispersion:
1. Range
2. Quartile Deviation
3. Mean Deviation
4. Standard Deviation

Measures of Skewness and Kurtosis

Correlation and Regression:
1. Karl Pearson Coefficient of Correlation
2. Spearman’s Rank Correlation
3. Simple Linear Regression
4. Multiple Regression

Testing of Hypothesis:
1. One Sample t test
2. Independent t test
3. Paired t test
4. Analysis of Variance – One way Classification
5. Analysis of Variance - Two way Classification
6. Chi Square Test : Independence of Attributes
7. Chi Square Test: Goodness of Fit
CORE – VI
STATISTICAL INFERENCE

Semester - II                                                                 Hours : 6
Code :                                                                 Credit : 5
Objective :

To give an exposure to a very vital part of Statistics – the Statistical Inference

Unit – I


UNIT – II


Unit – III


Unit – IV

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 - V

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

Books for Study:

Books for Reference:
CORE BASED ELECTIVE - VII

JAVA PROGRAMMING

Semester – II                  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.

Unit – III


Unit – IV


Unit – V


Book for Study:

Books for Reference:
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 $\beta_0$ and $\beta_1$- properties of the least square estimators - Estimation of $\sigma^2$- Hypothesis testing on the slope and intercept. Estimation by Maximum likelihood method - Interval estimation in simple linear regression: Confidence Intervals on $\beta_0, \beta_1$ and $\sigma^2$.

Unit - II

Multiple linear Regression models - Estimation of model parameters-Least Square estimation of the Regression coefficients-Properties of least square estimators- Estimation of $\sigma^2$ – Maximum Likelihood Estimation - Hypothesis testing in Multiple Linear Regression, Confidence interval in Multiple Regression coefficients.

Unit - III

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

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

Models of Time Series - Additive and Multiplicative models - Analysis and forecasting-Elimination of trend - Growth curve-modified exponential curve (Methods of three selected points only), Gompertz Curve, Logistic curve (Method of three selected points and Yule’s method).

Book for Study:

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

Unit – I

Unit – II

Unit – III

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.

Book for Study:

Book for Reference:
Core- P X

COMPUTER LAB FOR JAVA PROGRAMMING

Semester – II                      Hours : 6
Code :                           Credits : 4

Objective: To implement the Statistical Constants using JAVA Language.

List of Programs:

1. Currency Conversion
2. Counting number of digits
3. Sum of digits and reverse number
4. Prime number.
5. Mean & Standard Deviation
6. Correlation Coefficient
7. Sorting of numbers
8. Sorting of strings
10. Program to implement objects and class: Students’ result.
11. Graphic Class: Displaying a given message using Applet
12. Graphic Class: Drawing Lines and Rectangles
13. Graphic Class: Drawing Circles and Ellipses
14. Applet for drawing a Human Face
15. Applet for drawing Bar Chart.
16. Applet for drawing a Polygon
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

Unit – III

Unit – IV

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 of M/M/S. Non-Markovian Queues model (concept only).

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

Books for Reference:
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.

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

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

Unit - V

Books for Study:

Books for Reference:
2. Singal M.K. Asha Rani Singal , A First Course in Real Analysis, chand and Co, New Delhi.
Objectives:
To expose the students to the analysis of statistical data using Statistical software.

List of Topics:

Measures of Central Tendency, Measures of Dispersion and Skewness and Kurtosis

- Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean
- Range, Quartile Deviation, Mean Deviation and Standard Deviation
- Measures of Skewness and Kurtosis

Correlation and Regression:

- Karl Pearson Coefficient of Correlation
- Spearman’s Rank Correlation
- Simple Linear Regression
- Logistic Regression
- R-square and Multicollinearity

Test for Normality

Parametric test

- t test – one sample & two samples
- ANOVA – One way & Two way

Non-parametric Tests

- Chi-square test
- Run test
- One sample K-S test
- Two independent sample
- Two related sample
- K-related sample
- McNemar test

Data Reduction (manual calculation not necessary)

- Factor Analysis
- Cluster Analysis
- Discriminant Analysis
Objective: To give an exposure to students on the application of Statistics in biological studies.

Unit – I

Introduction to Survival Concepts: Survival Functions and Hazard Rates – Types of Censoring – Type I Censoring, Type II Censoring, Random Censoring, Other Types of Censoring.

Unit – II

Parametric Models: Distributions – Exponential, Gamma, Weibull and Lognormal; Estimation: Maximum Likelihood, Simple Problems.

Unit – III


Unit – IV

Nonparametric Methods-Two Samples: Gehan test, Mantel-Haenszel test, Efron Test – Simple Problems.

Unit – V


Book for Study:


Books for Reference:

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

Unit – I
Definition of vital statistics and vital events- uses of vital statistics, sources of vital statistics. Measurements of Fertility Rate-Crude Birth Rate, General Fertility Rate, Specific Fertility Rate, Total Fertility Rate, Gross Reproduction Rate and Net Reproduction Rate.

Unit – II
Measurement of Mortality- Crude Death Rate, Specific Death Rate, Infant Mortality Rate, Standardized Death Rates – Direct and Indirect method of standardization, Central Mortality Rate and Force of Mortality.

Unit – III
Life Table – Assumptions, Descriptions, Construction and Uses of Life Table. Definitions of \( l_x \), \( d_x \), \( npx \), \( p_x \), \( q_x \), \( L_x \) and \( T_x \). Expectation of life – Curate expectation and complete expectation of life. Basic theorems with proof.

Unit – IV
Life Assurance premiums: General considerations – Assurance benefits – Pure Endowment Assurance , Endowment Assurance, Temporary assurance, Whole life assurance – Commutation Functions \( D_x \), \( C_x \), \( M_x \) and \( R_x \) – Expressions for present values of Assurance benefits in terms of Commutation Functions. (Simple problems only)

Unit – V

Books for Study:


Books for Reference:

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

Unit – I

Simple Random Sampling - procedure of selecting a random sample, estimation of mean, variance and proportions-SRS for variables-SRS for attributes. Estimation of sample size.

Unit – II

Stratified Random Sampling - Introduction, principles of stratification, advantages of stratification, notations, estimation of population mean and its variance, allocation of sample size in different strata. formation of strata, determination of number of strata.post stratification-deep stratification.

Unit- II

New systematic Random Sampling - Introduction, comparison of systematic with simple and stratified random samples for some specified populations-population with periodic variations-auto – correlated populations-two-dimensional systematic sampling.

Unit - III


UNIT – IV

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


Book for study:


Books for Reference:

OBJECTIVE: To import the practical knowledge in the field of Sampling, Design and Testing of Hypothesis.

List of Topics:

i. Simple Random Sampling with and without replacement.

ii. Stratified Random Sampling.

iii. Systematic Sampling.

iv. Cluster Sampling.

v. Design: CRD, RBD, LSD with one and two missing observations.

vi. Factorial Experiments: $2^2, 2^3, 3^2$, Confounding & Partial Confounding with $2^3$

vii. Analysis of BIBD and PBIBD with two associate classes.

viii. Large Sample: Mean, Difference of Means, S.D, Difference of S.D’s, Proportion & Difference of Proportions.

ix. Small Sample: Mean, Difference of Means, Paired t test, Correlation Coefficient.

x. Non-Parametric Test: Sign, Median, Mann Whitney Wilcoxon U-test, Kolmogrov–Smirnov (one and two samples) tests.
CHOICE BASED ELECTIVE – III

LINEAR MODELS AND DESIGN OF EXPERIMENTS

Semester: IV                          Hours  : 6
Code :                Credits : 4

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

Unit – I
General linear model - models with full rank and less than full rank - least square and maximum likelihood estimators of the parameters and properties Gauss-Markov theorem - testing linear hypothesis.

Unit – II
Introduction to design of experiments – Efficiency of CRD, RBD & LSD – Missing plot techniques for RBD and LSD with one (or) two missing observations.

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
General block designs - concepts of connectedness, balancedness and orthogonality. – BIBD and its parametric relations – Information (C) matrix and criteria for connectedness of block designs - Intra and Inter block analysis of BIBD – concept of Youden square design.

Unit –V
PBIBD with 'm' associate classes – classifications and parametric relations of PBIBD – Intra block analysis of PBIBD – Need and scope of response surface experiments.

Books for Study:

Books for Reference:
CORE BASED ELECTIVE – IV
QUALITY ASSURANCE

Semester - IV
Hours : 6

Code : Credit : 4

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

Unit – I


Unit – II


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.

Book for Study :

Books for Reference:

# INTRODUCTION TO PYTHON

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**Objective:** To introduce the software skills to apply the statistical tools.

**Unit-I**
- Python Statements and Comments, Keywords and Identifier, Python Data types, Python I/O and Import, Python operators, If else statement, For loop, While loop, Break and Continue.

**Unit-II**

**Unit-III**
- Exception, Exception Handling, User-defined exception, Name space, Class, Inheritance, Multiple Inheritance, Operator overloading.

**Unit-IV**
- Data visualization in Python, Fitting of Distributions – Graphical and Statistical Procedures, Statistical Measures.

**Unit-V**
- User defined functions for parametric tests and Non parametric tests, Fitting Statistical Models – Simple Linear Regression and Multiple Linear regression.

**Book for Study:**

1. Python programming for Absolute Beginner, Third Edition By Michael Dawson – Cengage Learning

**Books for Reference:**

1. Python Data Analytics, Fabio Nelli – A press.
Objective: To create the consciousness about the simulation and Modelling.

Unit – I


Unit – II


Unit-III


Unit – IV


Unit – V

Verification and Validation of Simulation Models- Model Building, Verification, and Validation- Verification of Simulation Models- Calibration and Validation of Models.

Book for Study:

OBJECTIVE: TO MOTIVATE THE KNOWLEDGE OF DISCRETE MATHEMATICS.

Unit I
Sets, Relations & Functions: Property of binary relations, equivalence, compatibility, partial ordering relations, Hasse diagram, functions, inverse functions, compositions of functions, recursive functions.

Unit II
Mathematical logic: Logic operators, Truth tables, Theory of inference and deduction, mathematical calculus, predicate calculus, predicates and qualifiers.

Unit III
Groups & Subgroups: Group axioms, permutation groups, subgroups, cosets, normal subgroups, semi groups, free semi-groups, monoids, sequential machines, error correcting codes, modular arithmetic grammars.

Unit IV
Lattices & Boolean Algebra: Axiomatic definition of Boolean algebra as algebra as algebraic structures with two operations , basic results truth values and truth tables, the algebra of propositional functions, Boolean algebra of truth tables.

Unit V
Combinatorics & Recurrence Relations: Disjunctive and sequential counting, combinations and permutations, enumeration without repetition, recurrence relation, Fibonacci relation, solving recurrence relation by substitution, solving non-reurrence relation by conversion to linear recurrence relation.

Book for study:

Book for References:
STATISTICAL DATA ANALYSIS USING SAS

Objective:
1. To enable students to use SAS for Data processing
2. To expose students on the applications of Statistical Analysis using SAS

Unit-I
Data step and Proc Step, SAS Data Libraries, Creating dataset using data lines, Importing data using INFILE statement, Importing data using Proc Import, Creating HTML Output, Sub setting observations using conditional statements, Sub setting variables using Keep/Drop, Creating variables using IF-THEN else statements, Retain statement, FIRST., LAST.

Unit-II
SAS procedures, Sub setting in Procedures with the WHERE Statement, Sorting Data with PROC SORT, Printing Data with PROC PRINT, Summarizing Your Data Using PROC MEANS, Writing Summary Statistics to a SAS Data Set, Counting Data with PROC FREQ, Producing Tabular Reports with PROC TABULATE, PROC SORT, PROC SUMMARY

Unit-III
Modifying a Data Set Using the SET Statement, Stacking Data Sets Using the SET Statement, Interleaving Data Sets Using the SET Statement, Combining Data Sets Using a One-to-One Match Merge, Combining Data Sets Using a One-to-Many Match Merge, Merging Summary Statistics with the Original Data.

Unit-IV
SAS Macro Concepts, Substituting Text with Macro Variables, Creating Modular Code with Macros, Adding Parameters to Macros, Writing Macros with Conditional Logic, Writing Data-Driven Programs with CALL SYMPUT. Proc SQL, Using Proc SQL to create tables, Modifying tables, Aggregating tables, Stacking and Merging tables

Unit-V
PROC UNIVARIATE, PROC MEANS, PROC CORR, PROC PLOT, PROC FREQ, PROC TTEST, PROC NPAR, PROC ANOVA, PROC REG.

Books for Study:

DATA MINING

Semester -                              Hours   : 5
Code:          Credits :  4

Objective :     This course introduces the fundamental concepts of Data Mining

Unit - I

   Introduction:-  Data mining – Functionalities – Classification – Data Preprocessing

Unit- II

   Data Mining Primitives:-  Association Rules in large Data mining , KDD Process,
                            Fuzzy sets and logic, , Classification and Prediction:- Information retrieval, Dimensional
                            Modeling of Data, Pattern Matching.

Unit -III

   Models based on Summarization:- Bayes Theorem, Chi squared Statistics Regression, Decision Tree, Neural Networks, Genetic Algorithms.

Unit- IV

   Cluster Analysis: Introduction – Types of Data in Cluster Analysis, Partitioning Methods –
                    Hierarchical Methods- Density Based Methods – GRID Based Method – Model based Clustering
                    Method.

Unit- V

   Web Mining: - Introduction, Web data, Web Knowledge Mining Taxonomy, Web
               Content mining, Web Usage Mining Research, Ontology based web mining Research, Web
               mining Applications.

Books For Study
    Ltd  - New Delhi.

2.  K.P. Soman , Shyam Diwakar, V.Ajay ,2006, Insight into Data Mining Theory and