YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF SUBJECTS
B.Sc. MATHEMATICS, STATISTICS & COMPUTER SCIENCE
THIRD SEMESTER
ACADEMIC YEAR 2022-23 OF 2021-24 BATCH (CBCS)

Sl. No	Part	Subject Code	Title of the Subject	Hours/ Week	Duration of Semester Exams	Marks			Credits
						Internal	External	Total	
THEORY									
1	I	ES18101	Environmental Studies and Gender Sensitization (AECC-5)	3	3	40	60	100	3
2	II	G18MS1T / G18MS2T	Quantitative Aptitude/ Statistics - Data Analysis (GE-2) (ID)	2	3	40	60	100	2
3	II	MS18301	Numerical Analysis (SEC –2)	5	3	40	60	100	4
4	II	MS18302	Abstract Algebra (Core Course - 7)	4	3	40	60	100	4
5	II	BS20038	Statistical Methods (Core Course - 8)	4	3	40	60	100	4
6	II	MS20303	Operating Systems (Core Course - 9)	4	3	40	60	100	4
PRACTICALS									
7	II	G18MS1P G18MS2P	GE (ID) Lab	2	3	40	60	100	1
8	II	MS18304	Abstract Algebra Lab (Core-7)	2	3	40	60	100	1
9	II	BS20039	Statistical Methods Lab (Core -8)	2	3	40	60	100	1
10	II	MS20305	UNIX SHELL Programming Lab (Core -9)	2	3	40	60	100	1
Total				**30**		400	600	1000	**25**

Ability Enhancement Compulsory Course **(**AECC) General Elective (GE)

Skill Enhancement Course (SEC) Inter-Departmental/Inter-Disciplinary (ID)

GENERIC ELECTIVE (2022 - 23)

(INTER-DEPARTMENTAL/INTER-DISCIPLINARY)

UG COURSES

S. No	Name of the Department	GE Course
1	B.Sc. Chemical Technology	Solar Processing Technologies
2	B.Sc. Agricultural Science and Rural Development	Principles of Organic farming
3	B.Sc. Computer Science and Engineering	PC Operating Systems
4	B.Com Honors	Taxation
5	B.Sc. Electronics and Communication Technology	Repair and Maintenance of Home Appliances
6	B.Sc. Computer Systems and Engineering	PC Hardware and Software Installation
7	B.Com Marketing	Marketing Management
8	B.Sc. Biotechnology, Genetics and Chemistry	Medical Lab Technology
9	B.Com Business Studies	Banking
10	B.A Mass Communication	Photography
11	B.Sc. Food Technology and Management	Food Processing and Quality Control
12	B A Psychology, English Literature & Journalism	Communication Skills Career Skills Psychology for Living
13	B.Sc. Mathematics, Statistics & Computer Science	Quantitative Aptitude
		Data Analysis
14	B.Sc. Multimedia and Animation	Creative Arts
15	B.Com Computers	Accounting
16	Bachelor of Business Administration	Principles of Management
17	B.Com International Accounting and Finance	Project Management
18	B.Sc. Computer Data Science & Data Analytics Engg.	Python programming
19	B.Com Strategic Finance	Goods and Services Tax
20	B.Com Business Process Management	Financial Markets
21	B.Sc. Food Science, Nutrition and Dietetics	Principles of Food Science, Nutrition and Dietetics
22	B.Sc. Computer Science & Cognitive Systems	Introduction to Worksheet
23	B.Com Business Analytics	Principles of Insurance
24	B.Sc. Computer Science and Artificial Intelligence	LISP Programming
25	B.Sc. Computer Science and Cyber Security	Principles of Information Security

ENVIRONMENTAL STUDIES & GENDER SENSITIZATION
(AECC-5)

Credits : 3 **Semester: III**

Subject Code : ES18101 **No. of lecture hours: 45**

Objectives:

- To understand the importance of ecological balance for Sustainable Development
- To understand the impacts of developmental activities and mitigation measures
- To understand the environmental policies and regulations.
- To develop students sensibility with regard to issues of gender in contemporary India
- To provide a perspective on the socialization of men and women
- To expose the students to debate on the politics and economic works and on gender violence

Outcomes:

CO1: **Understand** the importance of Environmental education, conservation of natural resources & Understand the importance ofecosystems and biodiversity

CO2: **Understand** the pollution problems and Apply the environmental science knowledge on solid waste management, disaster management

CO3: **Apply** the environmental science knowledge to Improve the resources and Evaluate and understand the sustainable environmentalconditions and control methods

CO4: **Identify** the interactions and intersections of identities (e.g., gender,race, ethnicity, class, sexuality, and so on) and assess the ways in which they contribute to instances of privilege and power dynamicsacross cultures, space, and time. And their problems

CO5: **Understand** the gender problems and ways of addressing them, including interactions across local to global scales in communitiesand overcome inequalities with legislations

UNIT- I **9 Hrs**

NATURAL RESOURCES, ECOSYSTEMS, & BIODIVERSITY

- Definition, Scope and importance of environmental studies. Need for public awareness.
- Renewable & Non-Renewable resources, Brief account on Forests, Water, Minerals and Energy (Solar, Wind, and Geo-thermal & Bio-energy).
- Definition of Ecosystem, Structure and functions-food chains, food webs, ecological pyramids, producers, consumers and decomposers.
- Energy flow and example ecosystems--Forest, Desert, Aquatic ecosystems.
- Definition of Biodiversity, types (Genetic, Species, Ecosystem), India-mega diversity Nation.
- Hotspots, Threats to biodiversity, Conservation of biodiversity (In-Situ and Ex-Situ).

UNIT-II **9 Hrs**

ENVIRONMENTAL POLLUTION

- Definition of Environmental pollution
- Brief account of causes, effects, prevention and control measures of
  (a) Air pollution
  (b) Water Pollution
  (c) Soil pollution

(d) Noise pollution
(e) Marine Pollution

- Solid Waste Management: Causes, Effects & Control measures of urban and industrialwastes
- Disaster Management: floods, Earth quakes, and Cyclones.

UNIT-III **9 Hrs**

Social Issues and Environment

- Rain-Water Harvesting, Water-shed Management, and From Unsustainable to Sustainable Development.
- Global Warming, Ozone depletion, and Acid rains
- Environmental Legislation: Air Act, Water Act, Environmental Protection Act, Forest Act, Wildlife Act.
- Environmental & Human Health ---------- HIV/AIDS
- Welfare Programs Family, Women & Child Welfare, Population Explosion
- Role of Information Technology in Environmental Studies.

UNIT-IV **9 Hrs**

Gender Studies

- Why should we study gender issues?
- Socialization- Making women and making men
- Being together as equals-Through the lens of gender
- Missing women: Gender selection and its consequences
- Health issues of Women

UNIT-V **9 Hrs**

Gender & Labour-Gender Violence & Law

- House work: The invisible labour- my mother doesn't work "share the load"
- Sexual harassment – say no eve teasing – the caste based violence –Nirbhaya Act
- Domestic violence - Is home a safe place? - Blaming the victim-Domestic violence Act
- Forums of justice-Hindu Inheritance Act (2005)

Field Visit for Environmental Studies:

1. Visit to a local Polluted site- Industrial effluent plant/ Polluted Lake/Agricultural Land
2. Visit to any Ecosystem

ESSENTIAL READING (for Gender Sensitization)

1. A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, AsmaRasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu. 201. **Towards a World of Equals: A Bilingual Text on Gender**. Hyderabad: Telugu Akademi.

SUGGESTED READING
(for Environmental Studies)

1. Rajagopalan R. 2015.**Environmental Studies-from Crisis to Cure.** Third Edition.Chennai: Oxford University Press.
2. Dr D K Asthana and Dr Meera Asthana. 2014.**A Text Book of Environmental Studies** Revised Edition. New Delhi: S. Chand & Company.
3. Anubha Kaushik and C.P. Kaushik Published. 2016. **Perspectives in Environmental Studies.** Fifth Edition. New Delhi: New Age International.

(for Gender Sensitization)

4. Sen Amartya **More Than One Million Women Are Missing.** New York Review of Books 37.20 (20 December 1990). Print. **We Were Making History...Life Stories of Women in the Telangana People's Struggle**. New Delhi: Kali for Women. 1998.
5. Tripti Lahiri. **By the Numbers: Where Indian Women Work. Women's Studies Journal.** (14 November 2012). Available online at: <http://blogs.wsj.com/ India real time/2012/11/14/by – the numbers-where-Indian-women-work/>
6. K. Satyanarayana and Susie Tharu. Ed. **Steel Nibs Are Sprouting: New Dalit Writingfrom South India, Dossier 2: Telugu and Kanada** Code=3732.
7. Vimala. **Vantillu (The Kitchen)". Women Writing in India: 600 Bc to the Present. Volume II.** The 20th Century. Ed.Suise Tharu and K. Laltitha. Delhi: Oxford University Press, 1995.599-601.
8. Shatrughna, Veena. **Women's Work and its Impact on Child Health and Nutrition.** Hyderabad: National Institute of Nutrition, Indian Council of MedicalResearch .1993.

QUANTITATIVE APTITUDE
(GE Inter-Departmental/Inter-Disciplinary)

Credits: 2 **Semester: III**

Subject Code: GE18MS1T **No. of Lecture hours: 30**

Objective: To demonstrate various principles involved in solving Mathematical problems and Thereby reducing the time taken for performing job functions.

Outcomes:

CO1: Solve problems related linear equations, ratio and Proportion.
CO2: Analyze the difference between problems on percentages, profit loss and discount
CO3: Analyze the concepts of Simple interest and compound interest.
CO4: Learn the basic concepts of Time and work, Time and distance.
CO5: Create sequences and series in the form of arithmetic and geometric progressions.

UNIT –I **6 Hrs**

Simple equations, Ratio, Proportion, Variation

Simple equations - Definition of Linear Equations - Formation of simple equations Problems on Ages - Ratio and proportion - Definition of Ratio - Properties of Ratios Comparison of Ratios - Problems on Ratios- Compound Ratio - Problems on Proportion

UNIT- II **6 Hrs**

Averages – Percentages

Averages - Percentages– Introduction - Converting a percentage into decimals - Converting a Decimal into a percentage - Percentage equivalent of fractions Problems on percentages.

Profit and loss

Problems on Profit and Loss percentage- Relation between Cost Price and Selling price Discount and Marked Price- Two different articles sold at same Cost Price
Two different articles sold at same Selling Price - Gain% / Loss% on Selling Price.

UNIT- III **6 Hrs**

Simple interest and Compound interest

Simple Interest- Problems on interest and amount -Problems when rate of interest and time period are numerically equal - Compound Interest - Definition and formula for amount in Compound interest- Difference between simple interest and compound interest for 2 years on the same principle and time period.

Quadratic equations

General form of Quadratic equations -Finding the roots of Quadratic equations Nature of the roots - Relation between the roots

UNIT- IV **6 Hrs**

Time and work: Basic concepts – examples

Time and Distance: Definition – Average speed – distance covered is same, different – stoppage time per hour for a train – time taken with two difference modes of transport problems on Trains- Boats and streams.

UNIT –V **6 Hrs**

Arithmetic progression: nth term of A.P sum to n terms of an A.P
Geometric Progression. nth term of G.P sum to n terms of an G.P and in finite terms of G.P
Problems on Number series - Permutations and Combinations -Probability

ESSENTIAL READING:

1. Dr. Aggarwal RS. 2015. **Quantitative Aptitude.** New Delhi: S. Chand & Company.

SUGGESTED READING:

1. Abhijit Guha, 2005.**Quantitative Aptitude for Competitive Examinations.** 3rd edition. New Delhi: Tata Mc-Graw Hill Co.

DATA ANALYSIS (STATISTICS)

(GE Inter-Departmental/Inter-Disciplinary)

Credits : 2 **Semester: III**

Subject code : G18MS2T **No. of Lecture hours: 30**

Objective: To acquaint students with various statistical methods and their applications in Different fields.

Outcomes:

CO1: **Organize**, manage and present data and Analyze statistical data using measures of centraltendency.
CO2: **Analyze** the statistical data using dispersion and location.
CO3: **Analyze** the concepts of quality control, chance and assignable causes of variation, controlcharts for variables and attributes.
CO4: **Use** the program for optimizing the cost involved in transportation problems.
CO5: Develop and solve transformation models and assignment models.

UNIT I **6 Hrs**

Descriptive Statistics I: Frequency Distribution and graphical presentation of data, measures of central tendency (mean, median, mode, geometric mean and harmonic mean, with simple applications

UNIT II **6 Hrs**

Descriptive Statistics II: Absolute and relative measures of dispersion(range, quartile deviation, mean deviation and standard deviation) with simple applications, Importance of moments, central and non- central moments and their interrelationships (excluding proof), Sheppard's Corrections for moments for grouped data, Measures of skewness based on quartiles and moments of skewness based on quartiles andmoments and kurtosis based on moments with real life examples.(Applications only)

UNIT III STATISTICAL QUALITY CONTROL I : **6 Hrs**

Importance of SQC in industry. Statistical basis of Shewart control charts.
Construction of control charts for variables (mean, range, and standard deviation)
Construction of control charts for attributes (p, np, and c-charts with fixed and varying sample sizes)Interpretation of control charts.

UNIT-IV **6 Hrs**

Definition of transportation problem initial basic feasible solution by North West corner rule, Matrix Minima and VAM Methods.
Optimal Solution through Modi table for balanced and unbalanced transportation problem. Degeneracy in Transportation problem.
Transportation problems as a special case of linear Programming problem.

UNIT-V **6 Hrs**

Assignment Problem: Definition of Assignment Problem Assignment problem as a special case of T.P and L.P.P
Optimal solution using Hungarian Method for Balanced and Unbalanced problems Sequencing Problem –Introduction

Optimal sequence of n jobs on two machines and three machines without passing under appropriate conditions.

ESSENTIAL READING:

1. Gupta S.C. and Kapoor V.K.2000. **Fundamental of Mathematical Statistics.** New Delhi: S. Chand Company.
2. Gupta S.C. and Kapoor V.K.2000. **Fundamental of Applied Statistics.** Third Edition. New Delhi: S. Chand Company.
3. Sharma S.D. 2007 Operations Research. New Delhi: S. Chand & Co.

NUMERICAL ANALYSIS
(SEC –2)

Credits : 4 **Semester: III**

Subject Code: MS18301 **No. of Lecture hours: 75**

Objectives:

- To explain the importance of the numerical methods over the calculus methods.
- To use the methods derived from the interpolation formulas to obtain the derivative of afunction.
- To obtain the solution of the initial value problems by using Taylor series method, Euler'smethod and Runge-Kutta methods.

Outcomes:

CO1: Categorize the theoretical and practical aspects of the use of numerical methods.
CO2: **Explain** how the common numerical methods and are used to obtain approximate solutions to intractable mathematical problems.
CO3: **Develop** numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and thesolution of differential equations.
CO4: **Analyse** and evaluate the accuracy of common numerical methods.
CO5: **Select** appropriate numerical methods to apply to various types of problems in engineeringand science in consideration of the mathematical operations.

UNIT – I **15Hrs**

The calculus of finite differences: Difference formulae – The difference table 5
To express any value of the function in terms of leading terms and the leading difference of adifference table 5
The operator E- Factorial Notation – Method of representing any polynomial in Factorial Notation -Differences of zero – Examples 5

UNIT – II **15Hrs**

Interpolation: Interpolation with equal intervals
Newton- Gregory Forward and backward Interpolation formulae 5
Interpolation with unequal intervals -divided differences (Only Definition.) Newton's divideddifference Interpolation formula (Newton's formulae for unequal intervals)
Lagrange's Interpolation formula for unequal intervalsCentral difference Interpolation formulae
Gauss Interpolation formula 5
Stirling's Interpolation formula 5
Bessel's Interpolation formula

UNIT- III **15Hrs**

Numerical differentiation and Integration: Determination of First second and third order derivatives of the tabulated function Using Newton forward and backward Interpolation formulae Differentiation using Central difference Interpolation formulae 8
Numerical Integration using Trapezoidal rule, Simpson's 1/3Simple problems there on. – rule, 3/8 Simpson's 3/8 rule – 7

UNIT-IV	**15Hrs**
Solutions of Algebraic and Transcendental Equations:	
Introduction, Bisection method	5
The method of false position	5
The iteration method-Newton - Raphson method	5

UNIT – V	**15Hrs**
Numerical Solutions of Ordinary differential Equations:	
Euler's method	3
Improved Euler's method	4
Modified Euler's method	4
Runge-Kutta II & IV methods	4
Simple problems there on.	

ESSENTIAL READING:

1. Dr. Gupta P.P & Malik G.S.2004. **Calculus of finite differences and Numerical Analysis.** Meerut: Krishna Prakashan Media (P) Ltd.

SUGGESTED READING:

1. Dr. Goel B.S. and Dr. Mittal S.K. 2007. **Numerical Analysis.** Third Edition. Meerut: Krishna Prakashan Media (P) Ltd.
2. Sastry S.S. 2013. **Introductory Methods of Numerical Analysis.** Fifth Edition. New Delhi: PHI.

ABSTRACT ALGEBRA

(Core Course - 7)

Credits : 4 **Semester: III**

Subject Code : MS18302 **No. of Lecture hours: 60**

Objective: To give basic concepts of algebra and its applications.

Outcome:

CO1: **Demonstrate** important mathematical concepts in abstract algebra such as definition of agroup, order of a finite group and order of an element.

CO2: **Analyze** different types of subgroups such as normal subgroups, cyclic subgroups and understand the structure and characteristics of these subgroups.

CO3: **Solve** the algebraic problems using appropriate techniques.

CO4: **Analyze** the knowledge and understanding of fundamental concepts including groups,subgroups, normal subgroups, homomorphism and isomorphism.

CO5: **Demonstrate** knowledge and understanding of rings, fields and their properties.

UNIT-I	**12Hrs**
Group theory: Binary Operations - Definition and properties	
Groups – definition and elementary properties	4
Finite groups and group composition tables	4
Sub groups, Cosets, Lagrange's theorem and its applications	4

UNIT-II	**12Hrs**
Normal subgroups and Isomorphism of groups	
Normal subgroups, simple groups	2
Homomorphism of groups, isomorphism, definition and elementary properties	2
How to show that groups are isomorphic, fundamental theorem of homomorphism	2

UNIT-III	**12Hrs**
Permutations	
Functions and permutations, Examples	3
Groups of permutations, cycles and cyclic notation	
Even and odd permutations, The alternating groups	3
Cyclic groups – Elementary properties	3
The classification of cyclic groups, sub groups of finite cyclic groups	
Cayley's theorem, inner automorphism	3

UNIT-IV	**12Hrs**
Rings: Definition and basic properties	2
Fields - Integral Domains	4
Divisors of zero and cancellation laws	2
The Characteristic of a ring	
Some non – commutative rings Examples	2
Matrices over a field – The real quaternion	2

UNIT-V	**12Hrs**
Homomorphism of Rings	
Definition and Elementary Properties	4
Maximal ideals, Prime Ideals	2
Rings of polynomials	2
Polynomials in indeterminate form	2
The evaluation of homomorphism	2

ESSENTIAL READING:

1. Gallin Joseph A.2006. **Contemporary Abstract Algebra.** Second Edition. New Delhi: Narosa publishing house.

SUGGESTED READING:

1. Fraleigh John B. 2003.**A First Course in Abstract Algebra.** 3rd Edition. New Delhi: Narosapublishing house.
2. I.N. Herstein.2012. **Topics in Algebra.** Second Edition. New Delhi: Wiley Publications.
3. Venkateswara Rao V, Krishna Murthy N, Sharma B.V.S.S, Anjaneya Sastry S.2016.**B.Sc. Mathematics Volume-II.** New Delhi: S.Chand and Company.

STATISTICAL METHODS
(Core Course - 8)

Credits : 4 **Semester: III**

Subject Code : BS20038 **No. of Lecture hours: 60**

Objectives:

- To acquaint students with various statistical methods and their applications in different fields.
- To cultivate statistical thinking among students.
- To develop skills in handling complex problems in data analysis and research design.

Outcome: Students will be able to choose and apply an appropriate statistical analysis or modeling methods to solve problems arising in different research fields.

Outcome:

CO1: Calculate and interpret the correlation between two variables
CO2: Produces simple linear regression equations.
CO3: Analyze the categorical data and to study the association among them.
CO4: Understand problem of point estimation.
CO5: Obtain estimators using estimation methods like MLE and method of moments.

UNIT-I	**12Hrs**
Bivariate data, scattered diagram,	2
Principle of least squares, fitting of a straight line, quadratic and power curves	3
Concept of correlation, computation of Karl Pearson's correlation coefficient for grouped data and ungrouped data and its properties	4
Correlation ratio, Spearman's rank Correlation coefficient, its properties.	3

UNIT–II	**12Hrs**
simple linear regression, correlation verses regression,	4
properties of regression coefficients	4
Concepts of partial and multiple correlation coefficients (only for three variables)	4

UNIT-III	**12Hrs**
Analysis of categorical data, independence and association and partial association of attributes	7
Various measures of association (Yule's) for two way data and coefficient of contingency (Pearson and Tcherprow)	3
Coefficient of colligation	2

UNIT-IV	**12Hrs**
Concepts of population, parameter, random sample, statistic, Sampling distribution and standard error	
Standard error of sample mean(s) and sample proportion(s).	2
Exact sampling distributions	
Statement and properties of $\chi 2$	3
t and F distributions and their interrelationships	3

Independence of sample mean and variance in Random sampling from normal distributions
Point estimation of a parameter, concept of bias and mean square error of an estimate 1
Criteria of good estimator – consistency, unbiasedness, efficiency and sufficiency with examples 3

UNIT–V **12Hrs**

Statement of Neyman's Factorization theorem 3
Derivations of sufficient statistics in case of Binomial, Poisson, Normal and Exponential (oneparameter only) distributions 3
Estimation by method of moments 3
Maximum likelihood (ML), statements of asymptotic properties of MLE
Concept of interval estimation. Confidence intervals of the parameters of normal population byPivot method 3

ESSENTIAL READING:

1. Kapoor V.K. and Gupta S.C. 2007. **Fundamentals of Mathematical Statistics.** NewDelhi: S.Chand & Co.

SUGGESTED READING:

1. Goon A M, Gupta M K Das Gupta B.2007.**Outlines of Statistics Vol-II**. Kolkata: Theworld press Pvt. Ltd.
2. Hoel P.G.2000. **Introduction to Mathematical Statistics**. New Delhi: Asia Publishing house.
3. Sanjay Arora and Bansi Lal. 2007. **New Mathematical Statistics.** New Delhi: Satya Prakashan.
4. Hogg and Craig. 2005.**Introduction to Mathematical Statistics.** New Delhi: Prentice Hall of India.
5. Hogg, Tanis, Rao. 2005. **Probability and Statistical Inference**.7th edition. New Delhi: Pearson Publication.
6. Parimal Mukhopadhyay. 2009. **Mathematical Statistics.** New Delhi: New Central Book Agency.

OPERATING SYSTEMS
(Core Course -9)

Credits : 4 **Semester: III**

Subject Code : MS20303 **No. of Lecture Hours: 60**

Objective: To learn the core ideas in operating systems, process management, memory protection, CPU scheduling, concurrent programming, dead locks and file systems.

Outcome: Students will be able to describe, contrast and compare differing structures for operating systems.

Outcome:

CO1: Describe, contrast and compare differing structures for operating systems.
CO2: Understand and analyze theory and implementation of processes.
CO3: Understand what deadlock is and how it can occur when giving mutually exclusive access to multiple resources
CO4: Uunderstand the concepts of file system interface.
CO5: Define segmentation of Memory management in an Operating System.

UNIT – I	**12Hrs**
1. Introduction-What is an operating system, mainframe system, desktop systems	2
2. Multiprocessor systems, distributed systems, clustered systems	2
3. Real time systems, handheld systems	2
4. Operating system structures-system components	2
5. Operating system services, system calls	2
6. system programs, system structures, virtual machines	2

UNIT – II	**12Hrs**
1. Process concept-process concept, process scheduling	3
2. Operation on processes, cooperating processes	3
3. Inter process communication	3
4. Process scheduling-basic concepts, scheduling criteria, Scheduling algorithms.	3

UNIT – III	**12Hrs**
1. Process synchronization-critical section problem	3
2. Semaphores, monitors	3
3. Deadlocks-deadlock characterization, methods for handling deadlocks	3
4. Deadlock prevention, Deadlock avoidance, Deadlock detection	3

UNIT – IV	**12Hrs**
1. File system-file concept, access methods	3
2. Directory structure, file system mounting, file system sharing.	3
3. File system implementation-file system structure, file system implementation.	3
4. Directory implementation, allocation methods, free space management	3

UNIT – V	**12Hrs**
1 Memory management-swapping, contiguous memory allocation	2
2 Fragmentation-internal and external fragmentation	2
3 Paging, segmentation, segmentation with paging.	3

4	Virtual memory management-demand paging	2
5.	Page replacement algorithms, Thrashing and working set model.	3

ESSENTIAL READING

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 2006, **Operating System Concepts**, Wiley India.

SUGGESTED READING

1. Andrew S. Tanenbaum, 2001. **Modern Operating Systems**, 2nd Edition, Pearson Education, Asia.

QUANTITATIVE APTITUDE
(GE Inter-Departmental/Inter-Disciplinary)

Credits: 1 **Semester: III**

Subject Code: G18MS1P **No. of practical hours: 30**

Objective: To demonstrate various principles involved in solving Mathematical problems and Thereby reducing the time taken for performing job functions.

Outcome: Students will be able estimate and check answers to mathematical problems in order to determine reasonableness, identify alternatives, and select optimal results.

LIST OF PRACTICALS

1-3 Formation of simple equations -Problems on Ages Problems on Ratios - Problems on Proportion.
4. Percentages
5- 8. Commercial Arithmetic- Profit and Loss - Simple interest- Compound Interest -Discount
9. Time and work
10. Time and Distance
11. Arithmetic progression: nth term of A.P sum to n terms of an A.P
12. Geometric Progression. nth term of G.P sum to n terms of an G.P and in finite terms of G.P
13. Problems on Number series.
14. Permutations and Combinations.
15. Probability

DATA ANALYSIS (STATISTICS)
(GE Inter-Departmental/Inter-Disciplinary)

Credits : 1 **Semester: III**

Subject Code : G18MS2P **No. of practical hours: 30**

Objective: To acquaint students with various statistical methods and their applications in Different fields.

Outcome: Students will be able to choose and apply an appropriate statistical analysis or modeling methods to solve problems arising in different research fields using Office automation.

LIST OF PRACTICALS

1. Graphical presentation of data (Histogram, Frequency polygon, ogives) usingOffice automation.
2. Computation of measures of central tendency, dispersion and coefficients of skewness, kurtosis using Office automation.
3. Fitting of Binomial distribution- Office automation - Direct method using.
4. Fitting of Poisson Distribution- Direct method using Office automation
5. Computation of Correlation coefficient, forming regression lines using Office automation.
6. Small sample tests for mean(s), Paired t-test and Correlation Coefficient using Office automation
7. Small Sample test for single and difference of variances using Office automation.
8. c^2 test for goodness of fit and independence of attribute using Office automation.
9. ANOVA for one way and two-way Classifieds using Office automation.
10. Construction of $\bar{X}$, R and s-charts
11. Construction of p and n p charts with fixed n using Office automation.
12. Construction of p and n p charts with varying n using Office automation.
13. Construction of C and U charts.
14. Construction of O C Curve for Single Sampling plan.

ABSTRACT ALGEBRA PRACTICAL
(Core Course -7)

Credits : 1 **Semester: III**

Subject Code : MS18304 **No. of practical hours: 30**

Objective: To give basic concepts of algebra and its applications.

Outcome: Students will develop and apply the fundamental properties of abstract algebraic structures,their substructures, their quotient structure, and their mappings.

LIST OF PRACTICALS

1-3. Groups examples
4-5. Subgroups and Normal subgroups.
6-7. Groups of Permutations-Cycles and Cyclic Notation- Even and Odd Permutations TheAlternating Groups
8. Cyclic Groups- Elementary Properties – the classification of cyclic groups subgroups of finitecyclic groups.
9-11. Rings – the characteristic of a ring
12. Rings of polynomials
13-14. Polynomials in indeterminate form.
15. The evaluation of homomorphism.

STATISTICAL METHODS
PRACTICAL
(Core Course - 8)

Credits: 1 **Semester: III**

Subject Code: BS20039 **No. of practical hours: 30**

Objectives:

- To acquaint students with various statistical methods and their applications in different fields.
- To cultivate statistical thinking among students.
- To develop skills in handling complex problems in data analysis and research design.

Outcome: Students will be able to choose and apply an appropriate statistical analysis or modeling methods to solve problems arising in different research fields using Office automation.

LIST OF PRACTICALS

1. Generation of random samples from Uniform (0, 1), Uniform (a, b) and exponential distributions
2. Generation of random samples from Normal and Poisson distributions.
3. Fitting of straight line and parabola by the method of least squares.
4. Fitting of power curves of the type $y = ax^b$, $y = a\,b^x$ $y = ae^{bx}$ by the method of least squares.
5. Computation of Yule's coefficient of association.
6. Computation of Pearson's, Tcherprows coefficient of contingency.
7. Computation of correlation coefficient, forming regression lines for ungrouped data.
8. Computation of correlation coefficient, forming regression lines for grouped data.
9. Computation of multiple and partial correlation coefficients.
10. Computation of correlation ratio.
11. Simulation of random samples from Uniform (0,1), Uniform (a,b), Exponential, Normal and Poisson distributions using Office automation
12. Fitting of straight line and parabola by the method of least squares using Office automation.
13. Fitting of power curves of the type $y = ax^b$, $y = a\,b^x$ $y = ae^{bx}$ by the method of least squares using MS Excel.
14. Computation of correlation coefficient, forming regression lines using Office automation.
15. Computation of multiple and partial correlation coefficients using Office automation.

UNIX SHELL PROGRAMMING PRACTICAL
(Core Course -9)

Credits:1 **Semester: III**

Subject Code: MS20305 **No. of practical hours: 30**

Objectives:

- To understand the commands and programming constructs of Shell Programming.
- To understand various algorithms related to CPU scheduling and memory management.

Outcome: Students will be able to identify UNIX/Linux utilities and implement shell scripts to perform more complex tasks.

No of hours	Topics
1	Introduction to Vi Editor, File and Directory related Commands.
2	Miscellaneous Commands
3	Arithmetic in Shell Scripts
4	Sample programs using Shell Script
5-6	Decision making in Shell Script
7-8	Loop control structures in Shell Script.9-10 Implementation of UNIX System calls
11-12	Implementation of CPU Scheduling algorithms
13-15	Implementations of memory management algorithms

YEAR-WISE AND SEMESTER-WISE DISTRIBUTION OF SUBJECTS
B.Sc. MATHEMATICS, STATISTICS & COMPUTER SCIENCE
FOURTH SEMESTER
ACADEMIC YEAR 2022-23 OF 2021-24 BATCH (CBCS)

Sl. No.	Part	Subject Code	Title of the Subject	Hours/ Week	Duration of semester exams	Marks			Credits
						Internal	External	Total	
THEORY									
1	II	MS20401	Vector Calculus (SEC – 4)	4	3	40	60	100	4
2	II	MS20402	Operations Research (GE- 3)	4	3	40	60	100	4
3	II	MS20403	Real Analysis (Core Course-10)	4	3	40	60	100	4
4	II	BS20040	Statistical Inference (Core Course -11)	4	3	40	60	100	4
5	II	MS18404	DBMS (Core Course -12)	4	3	40	60	100	4
PRACTICALS									
6	II	MS20405	Real Analysis Lab (Core Course -10)	2	3	40	60	100	1
7	II	BS20041	Statistical Inference Lab (Core Course -11)	2	3	40	60	100	1
8	II	MS18406	Computer science Lab (Core Course -12)	2	3	40	60	100	1
9	II	MS18407	Web Programming (SEC-3)	1+2	3	40	60	100	2
TOTAL				**29**		360	540	900	**25**

* Generic Elective (GE**)** * Skill Enhancement Course (SEC)

VECTOR CALCULUS
(SEC – 4)

Credits : **4** **Semester: IV**

Subject Code : MS20401 **No. of Lecture hours: 60**

Objective: The objective of this course is to present a user friendly introduction to Vector Calculus and its many applications.

Outcome: Students will be able to develop specific skills, competencies and thought processessufficient to support further study or work in this or related fields.

Outcomes:

CO1: **Differentiate** and anti-differentiate a vector-valued function presented in symbolic form
CO2: **Find** the divergence and curl of a vector field and prove identities involving these.
CO3: **Use** the gradient operator to calculate the directional derivative of a function
CO4: **Understand** the parametric equations of curves and surfaces
CO5: **Understand** the various integral theorems relating line, surface and volume integrals

UNIT I	**12Hrs**
Vector Differentiation and ordinary derivatives of vectors	3
Continuity- Differentiability Gradient of a scalar field	3
Gradients, conservative fields and potentials	3
Applications of the gradient- Directional Derivative	3

UNIT-II	**12Hrs**
Divergence of a Vector Point function - Properties	4
Curl of a Vector Point function - Properties	4
Problems on Divergence and Curl	4

UNIT III	**12Hrs**
Properties of Divergence and curl- Theorems	4
Laplacian Operator and simple problems there on	4
Vector Integration- Line Integrals	4

UNIT-IV	**12Hrs**
Surface integrals- Volume integrals	6
Green's Theorem- and problems on Green's Theorem	6

UNIT V	**12Hrs**
Gauss's divergence theorem and problems related to Gauss's theorem	6
Stoke's Theorem and problems related to Stoke's Theorem	6

ESSENTIAL READING

1. P.C. Matthews, Vector Calculus
2. J.N. Sharma, A.R. Vasistha, 2013 **Vector Calculus**–Meerut: Krishna Prakashan, Mandir, for units (IV, V)

OPERATIONS RESEARCH
(GE- 3)

Credits: 4 **Semester: IV**

Subject Code: MS20402 **No. of Lecture hours: 60**

Objective: To understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively.

Outcome:

CO1: Identify the various techniques of operations research and to translate a real-world problem, given in words, into a mathematical formulation.
CO2: Construct the simplex table and to plan the optimum results.
CO3: Use the program for optimizing the cost involved in transportation problems.
CO4: Develop and solve transformation models and assignment models.
CO5: Design the sequence of jobs and to make up the total process time.

UNIT-I **12Hrs**

Operations research:

Meaning and scope of operations research	1
Convex sets and their properties, Definition of general LPP	1
Solution of linear programming problem by graphical method	1
Statements of fundamental theorem of LPP and other related theorems	2
Formulation of Linear Programming Problem	3
Optimum Solution of linear programming problem by simplex Method.	4

UNIT-II **12Hrs**

Concept of artificial variables	
Big M/Penalty method and two phase simplex methods	6
Concept of duality of LPP	1
Dual primal relationship, statement of fundamental theorem of duality	5

UNIT-III **12Hrs**

Definition of transportation problem	1
Transportation problems as a special case of linear Programming problem.	1
Initial basic feasible solution by North West corner rule, Matrix Minima and VAM Methods.	3
Optimal Solution through MODI and stepping stone method for balanced and unbalanced transportation problem.	4
Degeneracy in Transportation problem and resolving it.	2
Concept of transhipment problem	1

UNIT-IV **12Hrs**

Formulation and description of Assignment Problem and its variations	1
Assignment problem as a special case of T.P and L.P.P.	1
Unbalanced Assignment Problem	1
Optimal solution using Hungarian Method for	6
And Travelling salesmen problem and its solutions	3

UNIT-V **12Hrs**

Problem of Sequencing	2

Optimal sequence of N jobs on two machines	5
and three machines without passing under appropriate conditions.	5

ESSENTIAL READING:

1. Sharma S.D. 2007.**Operations Research.** New Delhi: S.Chand & Co.

SUGGESTED READING:

1. Kanti Swarup, P.K Gupta and Man Mohan. 2000. **Operations Research.** New Delhi: S.Chand Company Ltd.

REAL ANALYSIS

(Core Course -10)

Credits : 4 **Semester: IV**

Subject Code : MS20403 **No. of Lecture hours: 60**

Objective: To give an approach to the usual topics handled in one dimensional calculus- limits, Continuity, Differentiation, Integration, Sequences and Infinite series.

Outcome:

CO1: Categorize the real line as a complete, ordered field.
CO2: Use the definitions of convergence as they apply to sequences, series, and functions.
CO3: Identify the continuity, differentiability, and inerrability of functions defined on subsets ofthe real line.
CO4: Apply the Mean Value Theorem and the Fundamental Theorem of Calculus to problemsin the context of real analysis.
CO5: Explain the Riemann integrability and the Riemann-Stieltjes integrability of a bounded function and prove a selection of theorems concerning integration.

UNIT-I **12Hrs**

The Real Numbers:

The Algebraic and Order Properties of R - Absolute Value and Real Line The Completeness Property of R

Applications of the Supremum Property 3

Intervals (No question should be set from this part)

Sequences: Sequences and Their Limits;

Limits Theorems 2

Monotone Sequences Subsequences 3

The Bolzano- Weierstrass Theorem 2

The Cauchy Criterion, Problems 2

UNIT-II Infinite Series: **12Hrs**

Definition of infinite series 1

Convergence and divergence of the infinite series 1

Cauchy’s criterion, Comparison tests (Without proof) 2

p- Test 2

Ratio test and Cauchy’s nth root test 2

Simple problems there on for convergence of a series 2

Definition of absolute convergence and conditional convergence

Leibniz’s test and problems. 2

UNIT – III **12Hrs**

Limits: Limits of Functions 2

Limits Theorems 2

Some Extensions of the Limit Concept.

Continuous Functions:

Continuous Functions- Combinations of Continuous Functions	2
Continuous Functions on Interval	2
Uniform Continuity - definition	
Non Uniform Continuity Criteria	
Uniform Continuity Theorem.	2

UNIT-IV **12Hrs**

Differentiation: The Derivative- The Mean Value Theorems	2
Rolle's Theorem	2
Lagrange's mean value theorem	2
Cauchy's mean value theorem	2
Taylor's Theorem and Maclaurin's Theorems with Lagrange's and Cauchy's form of remainders.	2
Expansions of e^x, Sin x, cos x, $(1+x)^m$ and log (1+x)as power series.	2

UNIT-V **12Hrs**

The Riemann Integral:

Upper and lower Riemann sums	2
The Riemann Integral	2
Properties of Riemann Integrable Functions	6
The Fundamental Theorem of Integral Calculus.	2

ESSENTIAL READING:

1. Kenneth A Ross, Elementary Analysis-The Theory of Calculus, Undergraduate Texts in Mathematics, Springer Verlag.

SUGGESTED READING:

1. Venkateswar RaoV, Krishna Murthy N,Sarma B.V.S.S, AnjaneyaSastryS.2013.**Textbook of B.Sc. Volume II.** New Delhi: S.Chand & Company Ltd.
2. B.Sc. II year mathematics – Telugu Akademy
3. Apostol T. M.2002.**Calculus.** (Vol. I), John Wiley and Sons (Asia) P. Ltd.,
4. Bartle R.G. and Sherbert D. R. 2000.**Introduction to Real Analysis**, John Wiley andSons (Asia) P. Ltd.
5. Fischer E.1983.**Intermediate Real Analysis**, Springer Verlag.

STATISTICAL INFERENCE
(Core Course -11)

Credits: 4 **Semester: IV**

Subject Code: BS20040 **No. of Lecture hours: 60**

Objectives:

- To acquaint students with various statistical methods and their applications in different fields.
- To cultivate statistical thinking among students
- To develop skills in handling complex problems in data analysis and research design.

Outcome: Students will be able to draw inferences about the population from the analysis of thesample data.

Outcomes:

CO1: Explain the concepts of testing of hypothesis and explain N – P lemma.
CO2: Solve the problems related to large sample tests
CO3: Compute the chi-square test and interpret the results.
CO4: Knowledge about small sample tests, based t and F distributions.
CO5: Explain in detail and demonstrate the use of non-parametric statistical methods.

UNIT-I **12Hrs**

Concepts of statistical hypotheses, null and alternative hypothesis, critical region, two types oferrors, level of significance and power of a test.

One and two tailed tests, test function (non-randomized and randomized).	4
Neyman-Pearson's fundamental lemma for randomized tests.	2
Examples in case of Binomial	2
Poisson, Exponential	2
and Normal distributions and their power of the test functions.	2

UNIT-II **12Hrs**

Use of central limit theorem in testing	3
Large sample tests and confidence intervals for mean(s)	3
Proportion(s)	3
Standard deviation (s)	3

UNIT-III **12Hrs**

Fisher's Z – transformation for population correlation coefficient(s) and	
Testing the same in case of one sample and two samples.	2
Definition of order statistics and statement of their distributions	2
Tests of significance based on $\chi 2$ - $\chi 2$ test for specified variance,	2
Goodness of fit	3
Test for independence of attributes (r ´ s, 2 ´ k and 2 ´ 2 contingency tables)	3

UNIT-IV **12Hrs**

Tests of significance based on student's t – t – test for single sample specified mean,	2
Difference of means for independent and related samples,	6
sample correlation coefficient	2

F – test for equality of population variances	2

UNIT-V	**12Hrs**
Non-parametric tests-their advantages and disadvantages	2
Comparison with parametric tests.	
Measurement scale-nominal, ordinal, interval and ratio	2
One sample runs test, sign test	2
Wilcoxon-signed rank tests (single and paired samples)	2
Two independent sample tests: Median test	
Wilcoxon – Mann-Whitney U test	2
Wald Wolfowitz's runs test.	2

ESSENTIAL READING:

1. Kapoor V.K.and Gupta S.C. 2007. **Fundamentals of Mathematical Statistics.** New Delhi: S.Chand & Company PVT.LTD.

SUGGESTED READING:

1. Goon A M, Gupta M K, Das Gupta B.2007 **Fundamentals of Statistics. Vol-I**. Kolakota: The world press Pvt. Ltd.
2. Hoel P.G. 2005. **Introduction to Mathematical Statistics**. New Delhi: Asia Publishing houseIndia.
3. Hogg and Craig. 2000 **Introduction to Mathematical Statistics**. New Delhi: PHI.
4. Hogg, Tanis, Rao. **Probability and Statistical Inference**. 7th edition. New Delhi: PearsonPublication.
5. Siegal S, and Sidney. **Non-parametric Statistics for Behavioral Science**. NewDelhi: Tata Mc-Graw Hill.

DATABASE MANAGEMENT SYSTEMS (DBMS)
(Core Course-12)

Credits : 4 **Semester: IV**

Subject Code : MS18404 **No. of Lecture hours: 60**

Objective: To facilitate data access, enforcing data integrity, managing concurrency and restoring the data from backups.

Outcome:

CO1: Describe Entity Relationship and Enhanced ER model.
CO2: Understand the relational model, reduction to relation schema, relational algebra and normalization
CO3: Identify SQL- the standard language of relational databases and PL/SQL programming.
CO4: Explain the storage and file structure, storage access, indexing and hashing techniques of thedatabase.
CO5: Understand the concept of Transactions, recovery system and concurrency control.

UNIT- I	**12Hrs**
1. Introduction: Introduction to DBMS, System Structure	2
2. DDL, DML	2
3. Data Dictionary, Data base Administrator, Database manager	2
4. Database levels, Data Independence	1
5. Data Base Design and E-R model: Entity – Relationship model, properties	2
6. Constraints and Occurrences	1
7. Enhanced entity relationship model: generalization, Specialization Aggregation, Design Considerations	2

UNIT-II	**12Hrs**
1. Relational model: Structure, Reduction to Relational Schema	1
2. Relational Algebra	1
3. Modification of the Database	1
4. SQL: Data Definition, Basic Structure of SQL queries, Set operations, Aggregate functions, Null Values, Nested Sub queries, joins, Modifications of the database, Views	7
5. Normalization: First, Second, Third Normal forms and BCNF	2

UNIT-III	**12Hrs**
1. PL/SQL: Programming, procedures, Triggers, Cursors.	7
2. Authorization in SQL – Granting of privileges, Granting privileges in SQL, Roles	2
3. Revoking of privileges, Authorization on Views, functions and procedures	1
4. Application security – encryption techniques	1
5. Multimedia databases	1

UNIT-IV	**12Hrs**
1. Storage and File Structure: Overview of the physical storage media	1
2. Magnetic disks – physical characteristics of disks performance measures of disks	2
3. Storage Access – Buffer manager, Buffer replacement policies, file organization, organization of records in files	4

4. Indexing and Hashing – Index sequential, B+ tree index, static hash function, Dynamic Hashfunction, comparison of Hashing and Indexing 5

UNIT-V **12Hrs**

1. Recovery System: Failure classification 1
2. Storage structure- storage types, data access, recovery and atomicity, log-based recovery, check points 3
3. Transactions: Transaction concept, states, implementation of atomicity and Durability, concurrent executions, serializability, testing for serializability 3
4. Concurrency Control: Lock based protocols, locks, Granting of Locks, Two-phase Lockingprotocol, Dead lock handling 3
5. Distributed Databases – Homogeneous and Heterogeneous Databases, Distributed Data Storage. 2

ESSENTIAL READING:

1. Korth H.F. Silberschatz, S.Sudharshan, **Database System Concepts**. 5th Edition. New Delhi: Tata McGraw Hill Publishing Company Ltd.

SUGGESTED READING:

1. Ivan Bayross. **SQL, PL / SQL (The Programming Language of Oracle)**, NewDelhi: BPB publications.
2. Fred R.Mc Fadden, Jeffrey A Hoffer, Mary B.1999.**Modern Database Management**. 5thEdition.New Delhi: Prescott.

REAL ANALYSIS PRACTICAL
(Core Course-10)

Credits:1 **Semester: IV**

Subject Code: MS20405 **No. of practical hours: 30**

LIST OF PRACTICALS

1-3. Sequences
4- 6. Infinite series – p- Test, Comparison tests, Ratio test, Cauchy's nth root test
7. Absolute convergence and conditional convergence - Leibniz's test and problems 8 -10. Limits- Limits at Infinity- Infinite limits
11. Continuous Functions
12. Sequences and series of functions
13. Uniform Convergence
14. Mean value Theorems
15. Riemann Sums, Problems on Riemann Integral

STATISTICAL INFERENCE PRACTICAL
(Core Course-11)

Credits : 1 **Semester: IV**

Subject Code : BS20041 **No. of practical hours: 30**

Objectives:

- To acquaint students with various statistical methods and their applications in different fields.
- To cultivate statistical thinking among students
- To develop skills in handling complex problems in data analysis and research design.

Outcome: Students will be able to draw inferences about the population from the analysis of thesample data using office automation.

LIST OF PRACTICALS

1. Large samples tests for means (s), proportion (s), Standard deviation (s) and correlationcoefficient---
2. Small sample tests for single mean and difference of means (independent and dependentsamples) and correlation coefficient.
3. Small sample test for single and difference of variances.
4. $\chi 2$ – test for goodness of fit and independence of attributes.
5. Nonparametric tests for single and related samples (sign test and Wilcoxon signed rank test)and one sample runs test
6. Nonparametric tests for two independent samples (Median test and Wilcoxon Mann Whitney – U test, Wald – Wolfowitz's runs test)
7. Small sample tests for mean(s), paired t-test and correlation coefficient using Office automation.
8. Small sample test for single and difference of variances using Office automation
9. $\chi 2$ – test for goodness of fit and independence of attributes using Office automation

DBMS PRACTICAL
(Core Course-12)

Credits : 1 **Semester: IV**

Subject Code : MS18406 **No. of practical hours: 30**

Objective: To facilitate data access, enforcing data integrity, managing concurrency and restoring the data from backups.

Outcome: Students will be able to design principles for logical design of databases, includingthe E -R method and normalization approach.

LIST OF PRACTICALS

1. Creation of data base
2-3. Simple to complex condition query creation using SQL plus4-5. Using Triggers
6-7. Creation of forms for student information, Library information, Pay roll etc.
8. Writing PL / SQL procedures for data validation
9. Generation using SQL reports.
10. Creating pass word and security features for applications.
11. Usage of file locking, Table locking facilities in applications.
12-14. Creation of small, full-fledged data base application spreading over two three sessions.

WEB PROGRAMMING PRACTICAL
(SEC - 3)

Credits:2 **Semester: IV**

Subject Code: MS18407 **No. of Practical hours:45**

Objectives:
- To learn design of web pages through HTML and CSS.
- To create dynamic content through JavaScript and CSS.

Outcome: Students will be able to develop web pages and generate dynamic content using scripting language.

HTML
Structure of HTML page, Text formatting, Text Styles, Fonts, Headings, Hyper links and Anchors, Lists, Tables, Frames, Multimedia, HTML forms and controls.

JAVA SCRIPT:
Advantages of JAVA script, Basic Java Script programming syntax. Operators and Expressions,programming Constructs, Functions.

JAVA SCRIPT:
Objects and properties, Object hierarchy, Window Object, Location Object, History Object, User – Defined Objects, Cookies.

DHTML:
Cascading style sheets - Dynamic Styles- Mouse over effects - Dynamic content- Dragging anddropping.

ESSENTIAL READING:
1. Ivan Bayross. **Web Enabled Commercial Application Development using HTML, DHTML, JAVA script**: Perl CGI. BPB Publications.
2. Steven Holzner.
20. to draw polygons.