Bharatiya Vidya Bhavan

BHAVAN'S VIVEKANANDA COLLEGE
OF SCIENCE, HUMANITIES AND COMMERCE
(Reaccredited with 'A' grade by NAAC)
Autonomous College
Affiliated to Osmania University

PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: English for Technical Communication I
Effective from academic Year 2023-24
(60 Hours)

COURSE CODE: HDS121 **PPW: 4**
YEAR/SEMESTER: I/I **NO. OF CREDITS: 4**

COURSE OBJECTIVE: Introduction to effective communication and imparting basic skills for Technical Communication.

UNIT-WISE COURSE OBJECTIVES:

COb1: to promote effective communication by making students aware of the process, types and characteristics of effective communication; to **develop** reading comprehension and appropriate usage of tenses.
COb2: to achieve effective written communication through an awareness of examples, barriers and ways of overcoming barriers; to **develop** skills in Note Making, Summarizing, Précis, and appropriate usage of Abbreviations and Numericals.
COb3: to build effective oral communication skills through an awareness of examples, barriers and ways of overcoming barriers; to **develop** skills in Group Discussion, and appropriate usage of Active and Passive Voice.
COb4: to study Non-verbal Communication and Body Language; to **develop** skills in Email Writing, and appropriate usage of Punctuation and Capitalization.

UNIT-I:

1. Tenses
2. Communication Skills
   (Definition, Process, Types, Characteristics of Effective Communication)
3. Reading Comprehension

UNIT-II:

1. Abbreviations and Numericals
2. Written Communication
   (Definition, Examples, Barriers, Overcoming Barriers)
3. Note Making, Summarizing, Precis

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UNIT-III:

1. Voice (Active and Passive)
2. Oral Communication
   (Definition, Examples, Barriers, Overcoming Barriers)
3. Group Discussion

UNIT-IV:

1. Punctuation and Capitalization
2. Non-verbal Communication and Body Language
3. Email Writing

SUGGESTED READING:

1. V.R. Narayanaswamy. Strengthen Your Writing. Orient Blackswan.
2. Bhaskaran and Horsburgh. Strengthen Your English. OUP.
3. Wren and Martin. High School English Grammar and Composition. S Chand.
4. Sanjay Kumar and PushpLata. Communication Skills. OUP.
5. Rai and Rai. (2013). Business Communication. Himalaya Publishing House.

COURSE OUTCOMES:

At the end of the course students will be able to:

CO1: demonstrate an understanding ofeffective communication, reading comprehension and appropriate usage of tenses.

CO2: apply effective written communication skills and achieve Note Making, Summarizing, Précis, and appropriate usage of Abbreviations and Numericals.

CO3: implement effective oral communication skills and participate in Group Discussion, and make appropriate use of Active and Passive Voice.

CO4: exhibit an understanding ofNon-verbal Communication and Body Language, **compose** Emails, and **apply** appropriate Punctuation and Capitalization.

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PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: Differential Equations
Effective from academic Year 2023-24

COURSE CODE: HDS122 **PPW: 5 hours of lecture and 1 hour of tutorials**
YEAR/SEMESTER: I/I **NO. OF CREDITS: 5**

(75 Hours)

COURSE OBJECTIVE: This course is aimed at familiarising students with differential equations.

UNIT-WISE COURSE OBJECTIVES:

COb1: To identify and learn the first-order ODEs, methods of integrating factors and linear differential equations.
COb2: To acquire knowledge of solving Differential Equations first order but not of first degree.
COb3: To find the general solution of Higher order linear differential equations with constant coefficients.
COb4: To find the general solution of Higher order linear differential equations with nonconstant coefficients and Partial differential equations.

20 Hrs

UNIT-I:
Differential Equations of first order and first degree: Introduction - Equations in which Variables are Separable - Homogeneous Differential Equations - Differential Equations Reducible to Homogeneous Form - Linear Differential Equations - Differential Equations Reducible to Linear Form - Exact differential equations - Integrating Factors - Change in variables - Total Differential Equations - Simultaneous Total Differential Equations - Equations of the form $dx/P = dy/Q = dz/R$.

20 Hrs

UNIT-II:
Differential Equations first order but not of first degree: Equations Solvable for p Equations Solvable for y - Equations Solvable for x - Equations that do not contain x (or y) Equations Homogeneous in x and y - Equations of the First Degree in x and y - Clairaut's equation. Applications of First Order Differential Equations : Growth and Decay - Dynamics of Tumour Growth - Radioactivity and Carbon Dating - Compound Interest - Orthogonal Trajectories .

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UNIT-III: **15 Hrs**

Higher order Linear Differential Equations: Solution of homogeneous linear differential equations with constant coefficients - Solution of non-homogeneous differential equations $P(D)y = Q(x)$ with constant coefficients by means of polynomial operators when $Q(x) = be^{ax}$, b sin ax , b cosax , x^k, xv , ve^{ax} , Method of undetermined coefficients.

UNIT-IV: **15 Hrs**

Method of variation of parameters - Linear differential equations with non constant coefficients - The Cauchy - Euler Equation - Legendre's Linear Equations - Miscellaneous Differential Equations. Partial Differential Equations: Formation and solution- Equations easily integrable - Linear equations of first order.

PRESCRIBED BOOK:

"Differential Equations and Their Applications", Zafar Ahsan, Prentice Hall of India Learning Pvt .Ltd, 3- Edition, 2016.

Unit 1- Chapters:2[2.1 to 2.12]
Unit 2- Chapters:3[3.1&3.2]; 4[4.1 to 4.4 & 4.20]
Unit 3-Chapters:5[5.1 to 5.4]
Unit 4-Chapters:5[5.5 to 5.8]; 9[9.1 to 9.4]

REFERENCE BOOKS:

1. Frank Ayres Jr, Theory and Problems of Differential Equations.
2. Ford, L.R ; Differential Equations.
3. Daniel Murray, Differential Equations.
4. S. Balachandra Rao, Differential Equations with Applications and Programs.
5. Stuart P Hastings, J Bryce Mc Lead; Classical Methods in Ordinary Differential Equations.

COURSE OUTCOMES:

At the end of the course students will be able to:

CO1: Solve Differential equations of first order and first degree.
CO2: Calculate solutions of Differential Equations of first order but not of first degree and interpret applications of Differential Equations of first order & first degree.
CO3: Evaluate general solution of Higher order linear differential equations with constant coefficients.
CO4: Evaluate general solution of Higher order linear differential equations with non constant coefficients and formulate Partial Differential equations.

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Syllabus-B Sc I Year/Semester I
Effective from academic Year 2020-21
Programme Name: B Sc (Honours) Data Science
Course Name: Computational Statistics-**Course Code:** HDS123
(60 Hours)

HPW: 4 **Credits:4**

Course Objectives: The objective of this course is to expose descriptive statistics and probability by practical application of quantitative analysis and data visualization

COb1: To perceive the basic concepts in Statistics
COb2: To calculate and interpret the various descriptive measures of centrality, dispersion and higher-order measures of location.
COb3: To apply basic concepts of probability theory and theorems in simple, conditional and posterior probability.
Cob4: Understand the concept of random variables, how to identify them and use them to solve probabilistic problems.

UNIT –I

Introduction: Importance of statistics, concepts of statistical population and a sample - quantitative and qualitative data - collection of primary and secondary data,designing a questionnaire and a schedule. Measurement scales- nominal, ordinal, interval and ratio.Classification, tabulation, and visualization of data. **(15)**

UNIT-II

Descriptive Statistics: Measures of central tendency or location (mean, median, mode, geometric mean and harmonic mean) with simple applications. Absolute and relative measures of dispersion (range, quartile deviation, mean deviation and standard deviation) with numerical problems.

Moments - Importance of moments, central and non-central moments, and their interrelationships, Sheppard's corrections for moments for grouped data. Measures of Skewness based on quartilesand moments and kurtosis based on moments with numerical problems. **(15)**

UNIT-III

Probability: Basic concepts in probability - deterministic and random experiments, trail, outcome, sample space, event and operations of events, mutually exclusive and exhaustive events, equally likely and favorable outcomes with examples. Mathematical, Statistical and Axiomatic definitions of probability with merits and demerits. Conditional probability and Independent events. Addition and multiplication theorem for two, three events, Boole's Inequality and Bayes' Theorem – numerical problems. **(15)**

UNIT- IV

Random Variables: Definition of random variable, discrete and continuous random variables, probability mass function and probability density function with illustrations and

Distribution function , its properties(only statements). Expectation of a random variable and its properties. Definition of moment generating function (m.g.f), cumulant generating function (c.g.f), probability generating function (p.g.f) and characteristic function (c.f) and statements of their properties with numerical problems. Chebyshev's, and Cauchy-Schwartz's inequalities and their applications. **(15)**

Course Outcomes: After completeing this course students will be able to:

CO1: Develop skills in presenting quantitative and qualitative data using appropriate diagrams, tabulations and construction of frequency distributions.
CO2: Evaluate data using measures of central tendency, dispersion and interpret the higher order measures of cental tendency.
CO3: Calculate probabilities by applying probability laws and theory.
CO4: Apply key concepts of probability, including discrete and continuous random variables, Probability functions, Generating functions, expectations and variances.

Text Books:

1. V.K.Kapoor and S.C.Gupta: Fundamentals of Mathematical Statistics, Sultan Chand &Sons,New Delhi.
2. William Feller: Introduction to Probability theory and its applications. Volume- I, Wiley Publication
3. Hogg,Tanis,Rao:Probability and Statistical Inference.7th edition.Pearson Publication.

List of Reference Books:

1. Schaum's Outline of Probability and Statistics by Murray R Spiegel, John J. Schiller, R. Alu Srinivasan.
2. GoonAM,Gupta and Das Gupta B:Fundamentas of Statistics,Vol-I,the World press pvt.Ltd.,Kolkota
3. HoelP.G:Introduction to Mathematical Statistics, Asia Publishing house.
4. Sanjay Arora and BansiLal:New mathematical Statistics: Satya Prakashan,New Delhi
5. Hogg,Tanis, Rao:Probability and Statistical Inference.7th edition, Pearson Publication.
6. Statistics for B.Sc I year, Telugu Academy.
7. Statistics for Management - Levin & Rubin
8. Introduction to probability and statistics : principles and applications for engineering and the computing sciences / J. Susan Milton, Jesse C. Arnold.

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PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: Computational Statistics Practicals using Spreadsheet
Effective from Academic Year 2023-24

COURSE CODE: HDS123P
YEAR/SEMESTER: I/I

PPW: 2
NO. OF CREDITS: 1

COURSE OBJECTIVE: This course will provide practical knowledge to the students on Descriptive statistics and visualization of data elaborated in this course. MS- Excel is introduced in this practical

COb1: Analyze and interpret the first, second, and higher-order measures of central tendency Using MS-Excel.
COb2: Analyze and interpret the diagrams and graphs.

1. Computation of Measures of Central tendency Using MS Excel.
2. Computation of Measures of dispersion Using MS Excel.
3. Graphical Presentation of data (Histogram, Frequency polygon, Ogives) Using MS Excel
4. Diagrammatic Presentation of data (Bar and Pie), Box plot using MS Excel.
5. Computation of moments Using MS-Excel.
6. Computation of co-efficient of Skewness and Kurtosis – using MS Excel.

COURSE OUTCOMES:
Upon successful completion of the course, students able to:

CO1: knowledge of various types of data, their organization and evaluation of summary measures such as measures of central tendency and dispersion etc.
CO2 : able to learn how to draw different diagrams, graphs and interpret from that using MS-Excel..

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PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: Programming in 'C'
Effective from Academic Year 2023-24
(60 Hours)

COURSE CODE: HDS124 **PPW: 4**
YEAR/SEMESTER: I/I **NO. OF CREDITS: 4**

COURSE OBJECTIVE: To foster the students to develop C Programs.

UNIT-WISE COURSE OBJECTIVES:
CObj1: To discuss the computer software, Algorithms and basics of C language.
CObj2: To illustrate control statements, arrays, strings.
CObj3: To explain the usage of functions, pointers and dynamic memory allocation.
CObj4: To construct structures, unions, enumerated data types and file concepts.

Unit – I: Introduction to Software, Algorithms, Programming Concepts and Basics of C, Input/output and Control Statements.

Introduction to Software: Programming Languages, Compiling, Linking and Loading a program.
Introduction to Algorithms and Programming Concepts: Algorithm and Flowcharts.
Basics of C: Developing Programs in C, A Simple C Program, Structure of a C Program, Concept of a Variable, Data Types in C, Tokens, Operators and Expressions, Type Conversion in C.
Input and Output: Non-formatted Input and Output, Formatted Input and Output Functions.
Control Statements: Selection Statements, The Conditional Operator, The Switch Statement.

Unit – II: Iterative Statements, Arrays, Strings and Multidimensional Arrays.

Iteration: while Construct, for Construct, do-while construct, goto statement, Special Control Statements: return, break, continue, Nested Loops.
Arrays and Strings: One-dimensional Array: Declaration of a One-dimensional Array, Initializing Integer Arrays, Accessing Array Elements, Working with One-dimensional Array.
Strings: One-dimensional Character Arrays: Declaration of a String, String Initialization, Printing Strings, String Input, Character Manipulation in the String, Character Functions in ctype.h (Table 11.2), String manipulation, functions in string.h (Table 11.3).
Multidimensional Arrays: Declaration of Two-dimensional Array, Initialization of a Two-dimensional Array, Accessing Two-dimensional Arrays, Working with Two-dimensional Array.

Unit – III: Functions, Pointers and Dynamic Memory Allocation.

Functions: Concept of Function, Using Functions: Function Prototype Declaration, Function Definition, Function Calling, Call by Value Mechanism, Storage Classes: Storage Class Specifiers for Variables (Auto, Register, Static and Extern), Recursion.
Pointers in C: Introduction, Address of Operator (&), Pointer: Declaring a Pointer, Initializing Pointers, Indirection Operator and Dereferencing, Use of Pointers.
Dynamic Memory Allocation: Static memory allocation, Dynamic memory allocation, Freeing Memory, How malloc() and free() work.

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Unit – IV: User-defined Data Types, User-defined Variables and Files.

User-defined Data Types and Variables: Structures: Declaring a Structure and Structure Variables, Accessing the Members of a Structure, Initialization of Structures, Nesting of Structures, Array of Structures, Arrays within Structure, Union: Declaring a Union and its Members, Accessing and Initializing the Members of a Union, Structure versus Union, Enumeration Types.
Files in C: Introduction, Using Files in C: Declaration of File pointer, Opening a File, Closing and Flushing Files, Working with Text Files: Character Input and Output, End Of File (EOF), Detecting the End Of File using the feof() function.

PRESCRIBED BOOK:

PradipDey, Manas Ghosh, Computer Fundamentals and Programming in C(2e), June 2013.

REFERENCE BOOKS:

1. Ivor Horton, Beginning C, March 2013.
2. Ashok Kamthane, Programming in C, January 2015.
3. Herbert Schildt, The Complete Reference C, July 2017.
4. Paul Deitel, Harvey Deitel, C How To Program, Pearson Education Limited 2016.
5. Byron S. Gottfried, Theory and Problems of Programming with C, 1996.
6. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, March 1988.
7. B. A. Forouzan, R. F. Gilberg, A Structured Programming Approach Using C, January 2007.

COURSE OUTCOMES:

At the end of the course students will be able to:

CO1: Develop Algorithms and Simple C programs.
CO2: Implement different control statements.
CO3: Develop C programs using functions and pointers.
CO4: Apply the concepts of structures, unions, enumerated data types and files.

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CO4: Apply the concepts of structures, unions, enumerated data types and files.

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PROGRAM NAME: B.Sc (Honours) in Data Science
COURSENAME: PROGRAMMING IN 'C' LAB
Effective from Academic Year 2023-24

OURSE CODE: HDS124P
EAR/SEMESTER: I/I

PPW: 2
NO. OF CREDITS: 1

OURSE OBJECTIVE: To impart knowledge on 'C' Programming.
Ob1: To implement 'C' programs for Control Statements.
Ob2: To implement 'C' programs for Functions, Arrays, Structures, Pointers and Files.

. Program to demonstrate arithmetic operators.
. Program to find the sum of digits of a number.
. Program to reverse of a given number.
. Program to check whether the given number is even or odd.
. Program to display Fibonacci numbers.
. Program to display the sum of harmonic series.
. Program to demonstrate arithmetic operators using switch statement.
. Program to find greatest of three numbers.
. Program to display multiplication table of a given number.
0. Program to display prime numbers between given range.
1. Program to find the factorial of a given number.
2. Program to check the given number is Armstrong or not.
3. Program to check the given number is Palindrome or not.
4. Program to check whether the given number is prime or not.
5. Program to find the roots of a quadratic equation.
6. Program for sorting i) an integer array ii) strings.
7. Program to demonstrate i) Character functions ii) String functions.
8. Program for matrix i) addition, subtraction ii) matrix multiplication.
9. Program to display the transpose of a given matrix.
0. Program to display the trace of a given matrix.
1. Program to find factorial of a given number using function.
2. Program to demonstrate i) call by value and call by address mechanisms.
   ii)using recursion.
3. i) Program to demonstrate to declare a pointer and initialize a pointer.
   ii) Program to demonstrate dereferencing operator.
4. Program to demonstrate passing i) an array to a function ii) arrays of pointers.
5. Program to demonstrate i) pointer to array ii) Dynamic Memory Allocation functions.
6. Program to demonstrate Structures.
7. Program to demonstrate Nesting of Structures.
8. Program to demonstrate i) array of structures ii) arrays within structures.
9. Program to demonstrate i)Union ii) Enumerated data types.
0. Program to demonstrate basic text-file I/O operations.

COURSE OUTCOMES:
By the end of the course, Students will be able to:
CO1: Execute 'C' programs for various Control Statements.
CO2: Execute 'C' programs for Functions, Arrays, Structures, Pointers and Files.

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PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: OPERATING SYSTEMS
Effective from Academic Year 2023-24
(60 Hours)

PAPER CODE: HDS125
YEAR/SEMESTER: I/I

PPW: 4
NO. OF CREDITS: 4

COURSE OBJECTIVE: To familiarize the students with the concepts of Operating Systems, Process Management, Deadlocks and Memory Management

UNIT-WISE COURSE OBJECTIVES:

COb1: To explain the basics of Operating Systems and its structure.
COb2: To acquire knowledge on the Process scheduling algorithms
COb3: To be able to determine the best disk scheduling algorithm and the deadlock handling method.
COb4: To explain the importance of Memory and Virtual Memory Management.

UNIT-I: Introduction, Operating - System Structures.

Introduction- What Operating Systems Do – User View – System View, Computer System Organization - Computer-System Operation - Storage Structure, Computer System Architecture - Single Processor Systems - Multi Processor Systems - Clustered Systems.
Operating - System Structures: Operating - System Services, System Calls, Operating- System Structure- Simple Structure - Layered Approach – Microkernels – Modules - Hybrid Systems.

UNIT-II: Processes and CPU Scheduling.

Processes: Process Concept - The Process - Process State - Process Control Block - Threads. Process Scheduling - Scheduling Queues – Schedulers - Context Switch.

CPU Scheduling: Basic Concepts - CPU–I/O Burst Cycle - CPU Scheduler - Preemptive Scheduling - Dispatcher, Scheduling Criteria, Scheduling Algorithms- FCFS – SJF - Priority Scheduling - Round-Robin Scheduling.

UNIT-III: Deadlocks and Mass Storage Structure.

Deadlocks: System Model, Deadlock Characterization- Necessary Conditions - Resource-Allocation Graph, Methods for Handling Deadlocks, Deadlock Prevention - Mutual Exclusion - Hold and Wait - No Preemption - Circular Wait.
Mass Storage Structure: Overview of Mass-Storage Structure - Magnetic Disks, Disk Scheduling- FCFS Scheduling - SSTF Scheduling - SCAN Scheduling - C-SCAN Scheduling, RAID Structure - RAID levels (RAID Level 0, RAID Level 1, RAID Level 0+1, RAID Level 1+0).

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UNIT-IV: Memory Management Strategies and Virtual Memory Management.

Memory Management Strategies: Background- Basic Hardware - Address Binding - Logical vs Physical Address Space - Dynamic Loading - Dynamic Linking & Shared Libraries, Swapping- Standard Swapping - Swapping on Mobile systems, Contiguous Memory Allocation - Memory Protection - Memory Allocation – Fragmentation, Segmentation- Basic Method - Segmentation Hardware, Paging- Basic Method.
Virtual Memory Management: Demand Paging - Basic Concept,Page Replacement- Basic Page Replacement - FIFO Page Replacement - LRU Page Replacement.

PRESCRIBED BOOK:

1. Operating System Concepts by Abraham Silberschatz, Peter B Galvin, Gerg Gagne, Wiley India Pvt. Ltd.(9 e), Copyright © 2013.

REFERENCE BOOKS:

1. Naresh Chauhan, Principles of Operating Systems Thomas W. Doeppner, Operating Systems in Depth Andrew S. Tanenbaum, Modern Operating Systems, 1992.
2. William Stallings, Operating Systems – Internals and Design Principles, 2018.
3. Dhananjay M. Dhandhere, Operating Systems – A Concept Based Approach, 2003.

COURSE OUTCOMES: At the end of the course students will be able to:

CO1: Paraphrase the basic concepts of Operating Systems and its Structure.
CO2: Summarize the various Process Management Services and process scheduling algorithms.
CO3: Determine the Process Scheduling Algorithm or the Deadlock Handling Method to be used.
CO4: Discuss the process of Memory and Virtual Memory Managements.

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PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: OPERATING SYSTEMS Lab
Effective from Academic Year 2023-24

COURSECODE: HDS125P **PPW:2**
YEAR/SEMESTER: I/I **NO.OFCREDITS: 1**

Course Objective: To acquire knowledge on UNIX commands & shell Programming.

COb1: To gain knowledge of the basic UNIX commands.

COb2: To execute UNIX shell scripts.

Familiarity of LINUX shell commands

mkdir,cd,ls,cat,touch,rmdir,man,pwd,mv,cp,rm,cut,cal,date,factor,who,whoami,finger,wc,sort,grep,head,tail,

more,banner,mail,write,wall,ps,kill,nice.

1. Write a shell program to perform arithmetic operations.
2. Write a shell program to display sum, sum of square and sum of cube of 1-10 numbers using expressions.
3. Write a shell program to check whether the given number is even or odd.
4. Write a shell program to display days of a week using case statement.
5. Write a program to find factorial of a number using for loop.
6. Write a shell program to check whether the given number is prime number or not.
7. Write a program to check whether the given number is perfect or not using until loop.
8. Write a shell program to check whether the given number is palindrome or not.
9. Write a shell program to display sum of the digits of a given number using until loop.
10. To wish salutation depending upon time.
11. Program using system calls.
12. Write a CPU scheduling algorithm for FCFS.
13. Write a CPU scheduling algorithm for SJF.

COURSE OUTCOMES:
By the end of the Course, Students will be able to:

CO1: Execute various UNIX commands.
CO2: Practice shell programming.

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Effective from academic Year 2023-24
PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: English for Technical Communication II
PAPER CODE: HDS221
YEAR/SEMESTER: I/II
PPW: 4
NO. OF CREDITS: 4

(60 Hours)

COURSE OBJECTIVE: To impart advanced skills for effective Technical Communication for professional enhancement.

UNIT-WISE COURSE OBJECTIVES:

COb1: to promote awareness of Data/Professional Ethics, ability to Interpret Data and Transfer Information, and appropriate usage of Conditionals.
COb2: to enable students to Set Goals, Write Reports and useTechnical Vocabulary.
COb3: to impart Time Management skills and Presentation Skills, and make students aware of Common Errors and Misappropriations.
COb4: to develop Critical Thinking, ability to write Application for Job and CV, and Proofreading skills

UNIT-I: **15 Hrs**

1. Conditionals
2. Data/Professional Ethics
3. Data Interpretation and Information Transfer

UNIT-II: **15 Hrs**

1. Technical Vocabulary
2. Goal Setting
3. Report Writing

UNIT-III: **15 Hrs**

1. Common Errors and Misappropriations
2. Time Management
3. Presentation Skills (PowerPoint Presentation - Formal)

UNIT-IV: **15 Hrs**

1. Proofreading
2. Critical Thinking
3. Application for Job and CV Writing

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SUGGESTED READING:

1. R. C. Sharma and Krishna Mohan. Business Correspondence and Report Writing. Tata McGraw-Hill
2. Sanjay Kumar and PushpLata. Communication Skills. OUP.
3. Rai and Rai. (2013). Business Communication. Himalaya Publishing House.
4. V.R. Narayanaswamy. Strengthen Your Writing. Orient Blackswan.
5. Bhaskaran and Horsburgh. Strengthen Your English. OUP.

COURSE OUTCOMES:

At the end of the course students will be able to:

CO1: demonstrate Data/Professional Ethics, ability to Interpret Data and Transfer Information, and appropriate usage of Conditionals.
CO2: set Goals, **compose** Reports and **apply** Technical Vocabulary.
CO3: exhibit Time Management skills and Presentation Skills, and avoid Common Errors and Misappropriations.
CO4: apply Critical Thinking, **compose** Application for Job and CV, and **demonstrate** Proofreading skills

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(Reaccredited with 'A' grade by NAAC)
Autonomous College
Affiliated to Osmania University
Effective from academic Year 2023-24
PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: REAL ANALYSIS

PAPER CODE: HDS222 **PPW: 5 hours of lecture and 1 hour of tutorials**
YEAR/SEMESTER: I/II **NO. OF CREDITS: 5**

(75 Hours)

COURSE OBJECTIVES: This course is aimed at familiarising students with concepts of Real Analysis.

UNIT-WISE COURSE OBJECTIVES:

COb1: To learn basic properties of Sequences of Real numbers and their limits.
COb2: To acquire knowledge about Continuity and Limits of Real functions.
COb3: To explain the concepts of Derivatives of a Real function.
COb4: To analyse concepts of Riemann Integration.

25 Hrs

UNIT- I:
Sequences: Limits of Sequences- A Discussion about Proofs-Limit Theorems for Sequences, Monotone Sequences and Cauchy Sequences -Subsequences-Lim sup's and Lim inf's -Series-Alternating Series and Integral Tests .

15 Hrs

UNIT- II:
Continuity: Continuous Functions -Properties of Continuous Functions -Uniform Continuity -Limits of Functions

20 Hrs

UNIT- III:
Differentiation: Basic Properties of the Derivative - The Mean Value Theorem - * L'Hospital Rule - Taylor's Theorem.

15Hrs

UNIT- IV:
Integration : The Riemann Integral - Properties of Riemann Integral(Theorems without proof)-Fundamental Theorem of Calculus.

PRESCRIBED BOOK:

Kenneth A Ross, Elementary Analysis –The Theory of Calculus, 2nd Edition, Springer Publishers

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Unit 1-Chapters: 2[7,8,9(without proofs),10.1 to 10.11{10.4 to 10.7(without proofs)}. 11.1 to 11.8(11.2 without proofs),12(without proofs),14,15]

Unit 2- Chapters: 3[17.1,17.2,17.3 to 17.5(without proofs),18.1 to 18.6(18.1,18.3,&18.6 without proofs),19.1 to 19.5, 20.1 to 20.10(20.4 &20.5without proofs)]

Unit 3- Chapters:5[28.1,28.2, 29.1,29.2,29.3,29.4 to 29.8(without proofs),30.1, 30.2(without proofs),31.1 to 31.6]

Unit 4- Chapters:6[32.1 to 32.9, 33.1,33.2,33.5,33.7, 34.1]

REFERENCE BOOKS:

1. Introduction to Real Analysis by Robert G. Bartle & Donald R. Sherbert, ohn Wiley & Sons, Inc.(Third Edition)
2. A course of Real Analysis by Shanti Narayanan & PK Mittal.
3. William .F. Trench , Introduction to Real Analysis.
4. Lee Larson, Introduction Real Analysis.

COURSE OUTCOMES: After learning the course the students will be equipped with the various tools to solve problems that arise in several branches of science, appreciate how abstract ideas and rigorous methods in mathematical analysis can be applied to important practical problems.

CO1: Interpret properties of Sequences of Real numbers.

CO2: Analyse Continuity and Uniform continuity of Real functions and evaluate their Limits

CO3: Interpret the concept of Derivability of Real functions.

CO4: Summarise and synthesise the concepts Riemann Integration.

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PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: PROBABILITY AND STATISTICAL METHODS

PAPER CODE: HDS223
YEAR/SEMESTER: I/II

PPW: 4
NO. OF CREDITS: 4

Effective from academic Year 2023-24
(60 Hours)

COURSE OBJECTIVES:

COB1: Basic concepts of probability theory and theorems in simple, conditional and posterior probability.

COB2: The concept of random variables, how to identify them and use to solve probabilistic problems.

COB3: Apply concepts of various discrete and Continuous probability distributions to various real life problems.

COB4: The concept of association between two variables and forecast future values by regression equations.

UNIT-I: **15 Hrs**

Probability: Basic concepts in probability - deterministic and random experiments, trail, outcome, sample space, event and operations of events, mutually exclusive and exhaustive events, equally likely and favorable outcomes with examples. Mathematical, Statistical and Axiomatic definitions of probability with merits and demerits. Conditional probability and Independent events. Addition and multiplication theorem for two, three events. and Bayes' Theorem – numerical problems.

UNIT-II: **15 Hrs**

Random Variables: Definition of random variable, discrete and continuous random variables, probabilitymass function and probability density function with illustrations and Distribution function, its properties(only statements). Expectation of a random variable and its properties. Definition of moment generatingfunction (m.g.f), cumulant generating function (c.g.f), probability generating function (p.g.f) andcharacteristic function (c.f) and statements of their properties with numerical problems.

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Bivariate Random variables: Notion of bivariate random variable, bivariate distribution and statement of its properties. Joint, marginal and conditional distributions. Independence of random variables.-numerical problems.

UNIT-III:

15 Hrs

Discrete Distributions: Uniform, Bernoulli, Binomial, Poisson distributions. Properties of these distributions such as m.g.f, c.f., and moments up to fourth order and their real life problems. Reproductive property wherever exists.

Continuous distributions: Rectangular, Exponential and Normal distributions. Importance of Normal distribution. Properties of these distributions such as m.g.f, c.f., and moments up to fourth order, their real life problems.

UNIT-IV:

15 Hrs

Correlation & Regression: Product moment correlation coefficient and its properties. Bivariate data, scattered diagram, computation of correlation coefficient for ungrouped data, Spearman's Rank correlation coefficient and its properties. Partial and multiple correlation coefficients (only for three variables). Simple linear regression, lines of regression, properties of regression coefficients, co-efficient of determination, correlation verses regression.

TEXT BOOKS:

1. V.K.Kapoor and S.C.Gupta: Fundamentals of Mathematical Statistics, Sultan Chand &Sons, New Delhi.
2. William Feller: Introduction to Probability theory and its applications. Volume- I, Wiley Publication
3. Hogg,Tanis,Rao:Probability and Statistical Inference.7th edition.Pearson Publication.

LIST OF REFERENCE BOOKS:

1. Goon A M, Gupta and Das Gupta B:Fundamentas of Statistics, Vol-I, The World Press Pvt Ltd., Kolkota.
2. Hoel P.G:Introduction to Mathematical Statistics, Asia Publishing house.
3. M. Jagan Mahon Rao and Papa Rao: A Textbook of statistics paper-I.
4. Sanjay Arora and Bansi Lal: New mathematical Statistics: Satya Prakashan,New Delhi.
5. Sahasambandham- Vibhajana Siddantamulu – Telugu Academy.
6. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC. PHI.

COURSE OUTCOMES:

Students able to:

CO1: Calculate probabilities by applying probability laws and theory.

CO2: Apply key concepts of probability, including discrete and continuous random variables, Probability functions, Generating functions, expectations and variances.

CO3: Knowledge of important discrete and continuous distributions, their interrelations with real time applications.

CO4: Compute an interrelation between the variables using Correlation and regression analysis.

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Effective from academic Year 2023-24

PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: Exploratory Data Analysis Practicals using R Programming

COURSE CODE: HDS223P
YEAR/SEMESTER: I/II

PPW: 2
NO. OF CREDITS: 1

COURSE OBJECTIVE: *This course will provide practical knowledge to the students on Descriptive statistics, visualization of data and probability distributions elaborated in this course. R- Programming is introduced in this practical*

COB1: Analyze and interpret the first, second and higher-order measures of central tendency Using R-Programming.
COB2: apply standard discrete and Continuos probability distribution to different situations

Introduction – R Programming, Writing Code/Setting Working Directory, Data types, Reading data from external sources, storing data to external files.

1. Mathematical operations(addition, subtraction, multiplication, division, log x, ex, inverse) including problems
2. Computation of Measures of central tendency and dispersion using R
3. Data visualization and interpretation using R
4. Computation of Binomial Probabilities using R
5. Computation of Poisson Probabilities using R
6. Computation of Normal Probabilities using R
7. Computation of Exponential Probabilities using R
8. Computation of correlation coefficient for raw data Using R
9. Computation of simple regression equation using R
10. Computation of coefficient of determination using R

COURSE OUTCOMES:
Upon successful completion of the course, students able to:

CO1: Analyze various types of data, their organization, and evaluation of summary measures such as central tendency and dispersion measures, etc.
CO2: Learn how to fit various discrete and Continuous probability distributions through R-Programming.

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PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: Database Management Systems
Effective from Academic Year 2023-24
(60 Hours)

PAPER CODE: HDS224
YEAR/SEMESTER: I/II

PPW: 4
NO. OF CREDITS: 4

COURSE OBECTIVE: The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.

UNIT-WISE COURSE OBJECTIVES:

COb1: To impart knowledge of database concepts.
COb2: To get equipped with E-R and EER model.
COb3: To have the knowledge about Relational model and Normalization.
Cob4: To get information about database administration.

UNIT-I: Database Environment and Development Process.

Basic concepts and definitions, traditional file processing systems-Disadvantages of File processing system, Database Approach, Advantages of database approach, Costs and Risks of Database Approach-, Components of Database Environment. The Database Development Process-System Development Life Cycle - Three schema Architecture for Database Development -Range of Database Applications.

UNIT-II: Modeling Data in the Organization.

E-R Model – Sample E-R model, E-R model Notation.
Modeling the Rules of the Organization: Overview of the Business Rules –Scope of the Business rule-Data Names and Definition.
Modeling Entities and Attributes: Entities-Attributes-Modeling Relationships-Basic Conceptsand Definition in Relationships-Degree of Relationships - Cardinality constraints-minimum, maximum cardinality.(Case Study).
Enhanced E-R model – Representing Super type, Sub type, Representing Specialization and Generalization, Specifying Completeness Constraints, Specifying Disjointness Constraints, Specifying subtype discriminators, Defining Super type /Subtype Hierarchies. (Case Study).

UNIT-III: Logical Database Design and the Relational Model

Relational model – Definitions-Relational Data Structure-Relational keys-properties of Relation, Integrity constraints, Well Structured Relations.
Transforming EER diagrams into Relations-Map Regular entities-Map Weak entities-Map Binary relationship-Map Associative Entities-Map Unary Relationships.
Normalization –Steps in Normalization-Functional Dependencies-Convert to First Normal Form-Convert to Second Normal Form-Convert to Third Normal Form(Case Study), Merging Relations-Denormalization.

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UNIT-IV: Data and Database Administration

The Roles of Data and Database Administrators – Traditional Data administration-Traditional Database Administration-Trends in Database Administration. Managing Data Security-Threats to Data security-Establishing Client/Server Security.

Basic Recovery Facilities – Backup Facilities, Journalizing Facilities, Checkpoint Facility, Recovery Manager.

Recovery and Restart Procedures –Disk Mirroring, Restore/Rerun, Maintaining Transaction integrity Backward Recovery and Forward Recovery.

Types of Database Failures- Aborted Transactions, Incorrect data, System Failure, Database destruction.

PRESCRIBED BOOK:

1. Jeffrey A Hoffer, V Ramesh, HeikkiTopi - *Modern Database Management*, 12 edition, Pearson, 2016.

REFERENCE BOOKS:

1. Fred R Mc Fadden, Jeffrey A Hoffer, Mary B Prescott - *Modern Database Management*, 6th edition, Pearson Education, 2002.
2. Database System Concepts by Peter Rob and Carlos Coronel, 2002.
3. Database Management Systems Concepts by AviSilberschatz, Henry F.Korth, 2020.
4. C.J.Date, A.Kannan, S.Swamynathan, An Introduction to Database Systems, 8th edition, Pearson Education, 2006.

COURSE OUTCOMES:

CO1: Acquire knowledge on database concepts.
CO2: Understands about E-R and EER model.
CO3: Aware of Relational model and Normalization.
CO4: Understand technical and management roles of database administration & data administrator.

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PROGRAM NAME: B.Sc (Honours) in Data Science
COURSENAME: Database Management Systems Lab
Effective from Academic Year 2023-24

COURSECODE: HDS224
YEAR/SEMESTER: I/II

PPW: 2
NO.OFCREDITS:1

COURSE OBJECTIVE: To acquire knowledge on SQL Commands, SQL Operators, Joins, nested queries, views.

COb1: To impart basic concepts of SQL.

COb2: To get equipped with the concepts of Joins, nested queries, views.

- SQL Data types, DDL
- DDL, DML & DCL
- Column Constraints
- Functions in SQL (String, Date)
- Functions in SQL (Numeric, Aggregate)
- Group by and Order by Clauses, Set Operators.
- Joins (Cartesian, Equi)
- Joins(Outer, Self)
- Nested Queries, Indexes
- Views, Sequences

Queries relating to the above concepts using the Employee database.

An Enterprise wishes to maintain a database to automate its operations. Enterprise is divided into certain departments and each department consists of employees. The following two tables describes the automation schemas.

Dept (deptno, dname, loc)
Emp (empno, ename, job, mgr, hiredate, sal, comm, deptno)

Queries

1. Find out the details of top 3 earners of company.
2. Display those employees who joined the company before15th of the month?
3. Print a list of employees displaying 'less salary' if less than 1500 if exactly1500 display as 'Exact salary' and if greater than1500 display 'more salary'?
4. Update the employee salary by15%, whose experience is greater than 10 years.
5. Delete the employees, who completed 30years of service.
6. Determine the minimum salary of an employee and his details, who joined on the same date.
7. Determine the count of employees, who are taking commission.
8. Create a view to display employee details of SALES department.
9. Determine the employees, who are located at the same place.
10. Determine the department which does not contain any employees.

COURSE OUTCOMES:

By the end of the course, Students will be able to:

CO1: Execute various SQL commands and operators.

CO2: Practice SQL functions, Joins, nested queries and views.

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PROGRAM NAME: B.Sc (Honours) in Data Science
COURSE NAME: Programming in Java
Effective from Academic Year 2023-24
(60 Hours)

COURSE CODE: HDS225
YEAR/SEMESTER: I/II

PPW: 4
NO. OF CREDITS: 4

COURSE OBJECTIVE: To enable students with the concepts of Java Programming and develop GUI applications.

UNIT-WISE COURSE OBJECTIVES:

COb1: To discuss the features of Java and construct class programs with methods.
COb2: To illustrate types of Inheritance, Interfaces, Packages and Arrays concepts.
COb3: To explore the concepts of Exception handling, Multithreading and Input/Output.
COb4: To learn the concepts of AWT and Swings.

UNIT-I: Getting started with Java, Java Programming Constructs and Classes and Objects.

Getting started with Java: Java Essentials, JVM, Java Features, Structure of Java Program, Creatic Execution of Programs.
Java Programming Constructs: Data Types, Type Casting.
Classes and Objects: Principles of Object-Oriented Languages, Classes, Objects, Class Decla Creating Objects.
Method Declaration and Invocation, Method Overloading, Constructors – Parameterized Consti Constructor Overloading, Cleaning-up unused Objects.
Class Variables &Methods-static Keyword, this Keyword, and Command-Line Arguments.

UNIT-II: Inheritance, Interfaces, Packages and Arrays.

Inheritance: Introduction, Types of Inheritance, extends Keyword, Examples, Method Overriding final Keyword, Abstract classes.
Interfaces and Packages: Interfaces, Abstract Classes Verses Interfaces, Creating and Using P Access Protection.
Arrays: One-Dimensional Arrays, Two-Dimensional Arrays, Wrapper Classes, String Class.

UNIT-III: Exception, Multithreading and Input/output.

Exception: Introduction, Types, Exception Handling Techniques-try, catch, multiple catch, User Exception.
Multithreading: Introduction, Main Thread and Creation of New Threads –By Inheriting the Thre Thread Lifecycle, Thread Priority.
Input/Output: Introduction, java.io Package, Reading and Writing Data- Reading/Writing Con Input, Scanner Class.

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UNIT-IV: AWT, Event Handling and Swings.

AWT: Introduction, Components, Containers, Button, Label, Checkbox, Radio Buttons, TextField and TextArea.

Event Handling: Introduction, Event Delegation Model, Events Classes- ActionEvent, KeyEvent, MouseEvent, MouseWheelEvent. Event Listeners-ActionListener, KeyListener, MouseListener, MouseWheelListener.

Swings: Introduction, Differences between Swing and AWT, JFrame, JPanel.

PRESCRIBED BOOK:

Sachin Malhotra, Saurabh Choudhary, Programming in Java (2e), Oxford University Press, 2019.

REFERENCE BOOKS:

1. Bruce Eckel, Thinking in Java (4e), March 2006.
2. Herbert Schildt, Java: The Complete Reference (9e), June 2014.
3. Y. Daniel Liang, Introduction to Java Programming (10e), January 2014.
4. Paul Deitel, Harvey Deitel, Java: How To Program (10e), February 2014.
5. Cay S. Horsttnann, Core Java Volume I –Fundamentals (10e), December 2015.

COURSE OUTCOMES:

At the end of the course students will be able to:

CO1: Comprehend the features of Java and construct class programs with methods.
CO2: Apply the concepts of Inheritance, Interfaces, Packages and Arrays concepts.
CO3: Program the concepts of Exception handling, Multithreading and Input/Output.
CO4: Develop GUI programs using AWT and Swings.

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PROGRAM NAME: B.Sc. (Honours) in Data Science
COURSE NAME: Programming in Java Lab
Effective from Academic Year 2023-24

COURSE CODE: HDS225P **PPW: 2**
YEAR/SEMESTER: I/II **NO. OF CREDITS: 1**

COURSE OBJECTIVE: To enable students to apply Object-Oriented Concepts and develop GUI applications.

COb1: Learn to program concepts of OOPs, Arrays, Exception handling.
COb2: To illustrate the concepts of Multithreading, Input/Output, AWT and Swings.

1. Write a java program to demonstrate nested-if-else ladder.
2. Write a java program to demonstrate while loop.
3. Write a java program to demonstrate do-while loop.
4. Write a java program to demonstrate one-dimensional array.
5. Write a java program to demonstrate two-dimensional array.
6. Write a java program to demonstrate Method overloading.
7. Write a java program to demonstrate types of constructors.
8. Write a java program to demonstrate Method overriding.
9. Write a java program to demonstrate Single Inheritance.
10. Write a java program to demonstrate Multi-Level Inheritance.
11. Write a java program to demonstrate Hierarchical Inheritance.
12. Write a java program for the implementation of multiple inheritance.
    using Interface to calculate the area of a rectangle and triangle.
13. Write a java program to demonstrate of user-defined package creation.
14. Write a java program to demonstrate try and catch in exception handling.
15. Write a program for the following string operations:
    a. Compare two strings b. concatenate two strings c. Compute length of a string.
16. Write a java program to demonstrate Multithreading.
17. Write a java program to demonstrate FileInputStream and FileOutputStream Class.
18. Write a java program to display the following graphics using AWT.
    a. Lines b. Rectangles c. Circles d. Ellipses e. Arcs f. Polygons.
19. Write a java program to demonstrate KeyListener Interface.
20. Write a java program to demonstrate MouseListener Interface.
21. Write a java program to demonstrate Button, Checkbox, TextField in AWT.
22. Write a java program to demonstrate JFrame in Swings.

COURSE OUTCOMES:
At the end of the course students will be able to:

CO1: Apply OOPs Concepts, Arrays and Exception handling.
CO2: Implement Multithreading, Input/Output, AWT and Swings.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Abstract Algebra

COURSE CODE: HDS321 **PPW: 5L+1T**
YEAR/SEMESTER: II/III **NO. OF CREDITS: 5**

COURSE OBJECTIVE: This course is aimed at familiarising students with concepts in Abstract Algebra.

UNIT-WISE COURSE OBJECTIVES:

COb1: To learn basic algebraic structures like groups.
COb2: To acquire knowledge about Permutation Groups and Factor groups.
COb3: To explain the concepts of Homomorphism, Isomorphism and Rings.
COb4: To analyse various concepts of Rings and Fields.

UNIT-I:GROUPS-I

Groups: Definition and Examples of Groups, Elementary Properties of Groups, Finite Groups Subgroups-Terminology and Notation, Subgroup Tests, Examples of Subgroups. Cyclic Groups: Properties of Cyclic Groups, Classification of Subgroups Cyclic Groups. (Chapters: 2, 3 & 4)

UNIT -II: GROUPS-II

Permutation Groups: Definition and Notation, Cycle Notation, Properties of Permutations, A Check Digit Scheme Based on D_5.
Cosets and Lagrange's Theorem: Properties of Cosets, Lagrange's Theorem and Consequences, An Application of Cosets to Permutation Groups, The Rotation Group of a Cube and a Soccer Ball.
Normal Subgroups and Factor Groups: Normal Subgroups, Factor Groups, Applications of Factor Groups. (Chapters: 5, 7 & 9)

UNIT- III: GROUPS III & RINGS I

Group Homomorphisms: Definition and Examples, Properties of Homomorphisms, The First Isomorphism Theorem, Cayley's Theorem Isomorphisms, Automorphisms Introduction to Rings: Motivation and Definition, Examples of Rings, Properties of Rings, Subrings. (Chapters: 10, 6 &12)

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UNIT- IV: RINGS II

Integral Domains: Definition and Examples, Fields, Characteristics of a Ring. Ideals and Factor Rings: Ideals, Factor Rings, Prime Ideals and Maximal Ideals.
Ring Homomorphisms: Definition and Examples, Properties of Ring, Homomorphisms. (Chapters: 13, 14 &15)

Prescribed Text Book:

1. Contemporary Abstract Algebra, Joseph A Gallian, Cengage learning publishers,9th edition, 2016

Reference Books:

1. B.Sc. Second Year Mathematics, Algebra, SEM IV Telugu Academy, Edition 2021.
2. A First Course in Abstract Algebra, FraleighJ.B, Pearson publications,7th Edition, 2003.
3. Topics in Algebra, Herstein , I.N, Wiley India Pvt. Limited, 2nd Edition, 1991
4. Basic Abstract Algebra, Robert B. Ash, Dover Publications,1st Edition, 2007
5. Finite Group Theory, I Martin Isaacs, American Mathematical Soc.,1st Edition, 2008.
6. Advanced Modern Algebra, Joseph J Rotman, American Mathematical Soc, 2nd Edition, 2010.
7. Basic Abstract Algebra, Bhattacharya, P.B Jain, S.K; and Nagpaul, S.R, Cambridge University Press,2nd Edition, 1994.

COURSE OUTCOMES: After completion of course students will be able to

CO1: Interpret properties of basic Algebraic structures.
CO2: Compute and calculate permutations and factor groups.
CO3: Evaluate Homomorphism, Isomorphism and Rings.
CO4: Summarise and synthesise the concepts in Ring Theory.

28/07/2021

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Inferential Statistics

COURSE CODE: HDS322 **PPW: 4**
YEAR/SEMESTER: II/III **NO. OF CREDITS: 4**

COURSE OBJECTIVE: This course aims to provide students with a broad knowledge of mathematical statistics and a conceptual foundation in Inferential Statistics, emphasizing practical aspects of the interpretation of data.

UNIT-WISE COURSE OBJECTIVES:

COb1: Recognize the characteristics of a sampling distribution and estimation theory and hypothesis testing.
COb2: Demonstrate the use of large sample tests and its applications.
COb3: Demonstrate the use of exact Sampling distributions tests and its applications.
COb4: To learn and apply non-parametric techniques in real life problems.

UNIT-I:

Sampling distribution: Concept – Population, Sample, parameter, statistic, sampling distribution and standard error. Exact sampling distributions-definitions and properties of chi-square, t and F distributions.

Estimation: Point Estimation and Interval estimation, Concept of Unbiasedness, Consistency, Efficiency and Sufficiency (only Conceptual frame work) – Statement of Neyman's Factorization theorem. Maximum likelihood estimation (MLE) and their properties – Simple problems on MLE – Method of moments – Simple illustrations.

Hypothesis and General Test Procedures: Concepts and basic definitions of statistical hypotheses, Neyman - Pearson's fundamental lemma (Statement and Proof). Computation of two types of errors and Power of the test (Problems).

UNIT-II:

Large Sample Tests: Large sample tests for attributes and variables; confidence intervals for mean(s), proportion(s), and correlation coefficient(s).

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UNIT-III:

Small Sample Tests: Tests of significance based on χ^2, t and F. χ^2-test for goodness of fit, Single variance and test for independence of attributes. t – test for test for single mean, two means(independent and dependent). F- test for difference of variances.

UNIT-IV:

Non-Parametric Tests: Their advantages and disadvantages, comparison with parametric tests. One sample run test, sign test and Wilcoxon-signed rank tests (single and paired samples). Two independent sample tests: Median test, Wilcoxon –Mann-Whitney U test, Wald Wolfowitz's run test.

Prescribed Books:

1. Gupta, S. C., & Kapoor, V. K., Fundamentals of mathematical statistics, Sultan Chand & Sons, 2000.
2. Sanjay Arora and Bansi Lal. New mathematical Statistics, Satya Prakashan, New Delhi, 1989.
3. Hogg and Craig, Introduction to Mathematical Statistics, Printis Hall, 2019.
4. Parimal Mukhopadhyay, Mathematical Statistics, New Central Book Agency, 2000.

Reference Books:

1. Goon A M, Gupta M K, Das Gupta B, Fundaments of Statistics, Vol-II, The World Press Pvt. Ltd., Kolakota, 1976.
2. Hoel P.G, Introduction to Mathematical Statistics, Asia Publishing House, 1971.
3. Hogg,Tanis,Rao, Probability and Statistical Inference, Pearson, 7th edition, 2005.
4. William Feller, Introduction to Probability theory and its applications, Vol- I, Wiley Publication, 1968.
5. Sanjay Arora and BansiLal, New mathematical Statistics, Satya Prakashan, New Delhi, 1989.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Interpret point and interval estimation techniques to estimate the population mean, proportion and variance and testing procedures to real life problems.

CO2: Acquire the knowledge of large sample tests and their applications in real-life business situations.

CO3: Acquire the knowledge of inferential statistics and their applications in real-life business situations.

CO4: Acquire the knowledge of Nonparametric tests for solving various statistical problems.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Optimization Methods for Analytics

COURSE CODE: HDS323 **PPW: 4**
YEAR/SEMESTER: II/III **NO. OF CREDITS: 4**

COURSE OBJECTIVE: This course aims to develop knowledge in optimization techniques and understand, formulate & tackle the difficulties of optimization problems.

UNIT-WISE COURSE OBJECTIVES:

COb1: To impart knowledge in concepts and tools of Operations Research.
COb2: Determining the Optimum solution to the LPP by using Big –M method, Dual simplex method and its extensions to dual LPP.
COb3: Model formulation and applications that are used in solving Transportation problems.
COb4: Describe the theoretical workings of the solution methods for assignment problems and demonstrate their working by hand and solver.

UNIT-I:

Linear Programming: Introduction to OR, Convex sets and their properties, Nature, Scope, Functions, Formulation of LPP - Solving the LPP by graphical method. Fundamental theorem of LPP (Only Statement). Solving the LPP by simplex method, Two - phase simplex method.

UNIT-II:

Big - M Method: Solution to LPP using Big – M method (Penalty Method) and Concept of degeneracy and resolving it.

Duality: Concept of duality, duality as LPP, Dual-Primal relationship, solving the LPP by Dual simplex method.

UNIT-III:

Transportation Problem: Definition of transportation problem, TP as a special case of LPP, Initial basic feasible solutions by North-West Corner Rule, Matrix minimum methods and VAM. Optimal solution through MODI method and stepping stone method for balanced and unbalanced.

Transportation problem, Maximization in TP, Degeneracy in TP and resolving it, Concept of Transhipment problem.

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UNIT-IV:

Assignment Problem: Concept, Mathematical Formulation, Assignment problem as special case of TP and LPP Solution, Optimal solution using Hungarian method for Balanced and Unbalanced problems, Travelling Salesman Problem.

Prescribed Books:

1. Kranti Swaroop, P.K. Gupta andManMohan, Operations Research, 8th Revised Edition, Sultan Chand & Sons, New Delhi, India, 2000.
2. S D Sharma, Operations Research, Kedarnath Ramnath & Co. Meerut, 2017.
3. Handy A. Taha, Operations Research: An Introduction, 10th Edition, Pearson Education Limited, 2018

Reference Books:

1. Gass, Linear Programming Methods and Application, 5th Edition Paper back, Mc Graw Hill, 2011.
2. J. K. Sharma, Operation Research: theory and applications, 6th Edition, India Trinity Press, 2016.
3. K V Mittal and C Mohan, Optimizations methods in operations research and systems analysis, India New Age International, 2016.
4. Pradeep Prabhakar Pai, Operations research: principles and practice, India Oxford, 2012.
5. Wayne L. Winston, Operations Research,4thEdition,Thomson Press, India, 2004.
6. K Rajagopal, Operations Research, India PHI learning Private Limited, 2012.
7. Frederick S. Hiller, Introduction to Operations research, India Tata McGraw Hill Education Pvt Ltd, 2010.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Identify and express a decision problem in mathematical form and solve it graphically and by Simplex method.
CO2: Explain the relationship between a linear program and its dual, including strong duality and complementary slackness.
CO3: Recognize and formulate transportation problems and drive their optimal solution.
CO4: Recognize and formulate Assignment problems and drive their optimal solution.

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Accredited with 'A' grade by NAAC
PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Data Analysis Practical using Python and TORA I

COURSE CODE: HDS322P **PPW: 2**
YEAR/SEMESTER: II/III **NO. OF CREDITS: 1**

COURSE OBJECTIVE: This course aims to provide students with a broad overview of the goals, assumptions, and modes of performing Statistical Inference& Optimization techniques to interpret data using Statistical software.

COb1: Perform inference on testing of hypothesis for solving real-life problems using Python.
COb2: Optimization model and its applications are demonstrated for solving problems using TORA.

1. Test for single proportion using Python.
2. Test for difference between proportions using Python.
3. Test for single mean using Python.
4. Test for difference between means using Python.
5. Test for correlation coefficient using Python.
6. χ^2 tests for goodness of fit using Python.
7. χ^2 tests for independence of attributes using Python.
8. Solution of LP problem by Graphical method using TORA.
9. Solution of LP problem by simplex method using TORA.
10. Solution of LP problem by Big-M method using TORA.
11. Solution of LP problem by Two – phase method using TORA.
12. Determination of Optimum solution to TP using MODI algorithm using TORA.
13. Determination of Optimum assignment problem (Balanced and unbalanced) for all cases using TORA.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Understand the process of drawing conclusions about population or scientific truths from real-life problems.
CO2: Use classical optimization techniques and numerical methods of optimization problems using TORA.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Python Programming

COURSE CODE: HDS324 **PPW: 4**
YEAR/SEMESTER: II/III **NO. OF CREDITS: 4**

COURSE OBJECTIVE: To familiarize the students with Python programming.

UNIT-WISE COURSE OBJECTIVES:

COb1: To demonstrate the concepts of Python programming.
COb2: To acquire knowledge of functions, lists, tuples and dictionaries.
COb3: To be able to demonstrate the concepts of classes and objects.
COb4: To explain the importance of polymorphism, inheritance, operator overloading and interfaces.

UNIT-I: Introduction to Python, Control Statements, Arrays

Introduction to Python: Python, Features of Python, Flavours of Python, Comparison between C and Python, Input and Output statements, Data types in python, Operators in Python.
Control Statements: The if, the if-else, the if-elif-else statements, the while loop, the for loop.
Arrays: Types of arrays, working with arrays using numpy.

UNIT- II: Functions, Lists and Tuples, Dictionaries

Functions: Defining a function, calling a function, Formal and Actual arguments, returning results from a function, returning multiple values from a function.
Lists and Tuples: Creating lists using range() function, Functions to process lists, Creating tuples, Functions to process tuples.
Dictionaries: Operations on Dictionaries, Dictionary functions.

UNIT -III: Introduction to OOPs, Classes and Objects

Introduction to OOPs: Problems in Procedure Oriented Approach, Features of Object Oriented Programming System.
Classes and Objects: Creating a class, the Self variable, Constructor, Types of Variables, Types of methods: Instance methods, Class methods, Static methods, Passing members of one class to another class, Inner classes.

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UNIT-IV: Inheritance and Polymorphism, Abstract classes and Interfaces

Inheritance and Polymorphism: Types of Inheritance: Single and multiple inheritance, Constructors in Inheritance, The super() method, Polymorphism :Method overloading, Operator overloading, Method overriding.
Abstract classes and Interfaces: Abstract method and abstract class, Interfaces in Python, Abstract classes vs Interfaces.

Prescribed Book:

1. Core Python Programming, Dr.R.Nageswara Rao, Dreamtech Press, Second Edition, 2019.

Reference Books:

1. Python for Beginners, Harsh Bhasin, New Age International (P) Ltd. Publishers, 1st Edition, 2019.
2. Learning Python, Mark Lutz, Davis Ascher, O'Reilly Media Inc, Second Edition, 2003.
3. The complete reference Python, Brown Martin C, McGraw Hill Education India,4thEdition,2018.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Write basic Python Programs.
CO2: Implement lists, tuples and dictionaries.
CO3: Apply the concepts of classes and objects.
CO4: Execute inheritance, polymorphism and Interfaces using Python.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Python Programming Lab

COURSE CODE: HDS324P **PPW: 2**
YEAR/SEMESTER: II/III **NO. OF CREDITS: 1**

COURSE OBJECTIVE: To impart knowledge on Python Programming.

COb1: To implement Python programs for Control Statements.
COb2: To implement Python programs for Object-Oriented Programming Concepts.

1. Python program to demonstrate if…else, elif.
2. Python program to demonstrate while loop.
3. Python program to demonstrate for loop.
4. Python program to demonstrate range() function.
5. Python program to demonstrate user-defined function.
6. Python program to demonstrate nested loops.
7. Python program to split the array and add the first part to the end.
8. Python program to demonstrate operations on dictionaries.
9. Python program to demonstrate functions to process lists.
10. Python program to demonstrate functions to process tuples.
11. Python program to demonstrate operations on numpy.
12. Python program to add two matrices.
13. Python program to create class, object and method.
14. Python program to demonstrate self-variable and constructor.
15. Python program to demonstrate static methods.
16. Python program to demonstrate multiple inheritance.
17. Python program to demonstrate method overloading.
18. Python program to demonstrate method overriding.
19. Python program to demonstrate operator overloading.
20. Python program to demonstrate the super() method.
21. Python program to demonstrate abstract method and abstract class.
22. Python program to demonstrate interfaces.

COURSE OUTCOMES: At the end of the practical course students will be able to

CO1: Execute Python programs for Control Statements.
CO2: Execute Python programs for Object-Oriented Programming Concepts.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Data Structures

COURSE CODE: HDS325 **PPW: 4**
YEAR/SEMESTER: II/III **NO. OF CREDITS: 4**

COURSE OBJECTIVE: To familiarize the students with concepts of Data Structures using C language.

UNIT-WISE COURSE OBJECTIVES:

COb1: To explain the concepts of Searching and Sorting.
COb2: To acquire knowledge of Stacks and Queues.
COb3: To be able to demonstrate the operations on Linked Lists.
COb4: To illustrate the concepts of Trees and Graphs.

UNIT-I: Introduction to Data Structures and Algorithms, Searching and Sorting

Introduction to Data Structures and Algorithms: Basic Terminology: Elementary Data Structure Organization, Classification of Data Structures, Operations on Data Structures.
Searching and Sorting: Introduction to Searching, Linear Search, Binary Search, Interpolation Search. Introduction to Sorting, Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort.

UNIT- II: Stacks and Queues

Stacks: Introduction to Stacks, Array representation of Stacks, Operations on a Stack: Push, Pop, Peek operations, Applications of Stacks: Reversing a list, Conversion of an Infix expression into a Postfix expression, Recursion.
Queues: Introduction to Queues, Array representation of Queues, Types of Queues: Circular Queues, Priority Queues, Deques, Applications of Queues.

UNIT -III: Linked Lists, Doubly Linked Lists, Circular Linked Lists

Linked Lists: Introduction, Basic Terminologies, Linked Lists versus Arrays, Singly Linked Lists: Traversing a Linked List, Searching for a value in a Linked List, Inserting a new node in a Linked List, Deleting a node from a Linked List.
Doubly Linked Lists: Inserting a New node in a Doubly Linked List, Deleting a Node from a Doubly Linked List.
Circular Linked Lists: Inserting a New Node in a Circular Linked List, Deleting a Node from a Circular Linked List.

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UNIT-IV: Trees, Graphs

Trees: Introduction-Basic Terminology, Types of Trees, Creating a Binary Tree from a General Tree, Traversing a Binary Tree: Pre-order, In-order, Post-order, Applications of Trees, Binary Search Trees, Operations on Binary Search Trees: Searching for a Node in a Binary Search Tree, Inserting a new Node in a Binary Search Tree, Deleting a Node from a Binary Search Tree.

Graphs: Introduction, Graph Terminology, Directed Graphs: Terminology of a Directed Graph, Representation of Graphs: Adjacency Matrix Representation, Adjacency List Representation, Graph Traversal Algorithms: Breadth-First Search algorithm, Depth-First Search algorithm.

Prescribed Book:

1. Data Structures Using C, Reema Thareja, OXFORD University Press, Second Edition, 2014.

Reference Books:

1. Data Structures using C, Aaron M. Tenenbaum, YedidyahLangsam, Moshe J. Augenstein, Pearson, 1st Edition, 2019.
2. Data Structures using C, A.K. Sharma, Pearson India, Second Edition, 2013.
3. Data Structures Using C, Balagurusamy E ,Tata McGraw-Hill Education India.1st Edition,2013.
4. Data Structures with C, Seymour Lipschutz, Schaum's Outline Series, Tata McGraw-Hill Education India, 2nd Edition, 2015.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Write searching and sorting programs.
CO2: Implement all the operations of Stacks and Queues.
CO3: Implement Singly Linked Lists, Doubly Linked lists and Circular Linked Lists.
CO4: Implement all the operations of Trees and Graphs.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Data Structures using C Lab

COURSE CODE: HDS325P **PPW: 2**
YEAR/SEMESTER: II/III **NO. OF CREDITS: 1**

COURSE OBJECTIVE: To enable students with the knowledge of Searching and Sorting techniques, Stacks, Queues and Binary Search Trees.

Cob1: To implement C Programs for Searching and Sorting Techniques.
Cob2: To implement C Programs for Linear Data structures and Binary Search Trees.

1. Program to demonstrate Linear Search.
2. Program to demonstrate Binary Search.
3. Program to demonstrate Interpolation Search.
4. Program to implement Bubble Sort.
5. Program to implement Selection Sort.
6. Program to implement Insertion Sort.
7. Program to implement Merge Sort.
8. Program to implement Quick Sort.
9. Program to implement PUSH and POP operations on Stack using array method.
10. Program to implement insert and delete operations on Queue using array method.
11. Program to implement insert and delete operations on Priority Queue.
12. Program to insert, delete and display operations on a Single Linked list.
13. Program to implement PUSH and POP operations on Stack using a Single Linked list.
14. Program to implement insert and delete operations on Queue using a Single Linked list.
15. Program to insert, delete and display operations on a Doubly Linked list.
16. Program to construct Binary Search Tree and implement Tree Traversing Techniques.
17. Program to insert a new node in a Binary Search Tree.
18. Program to delete a leaf node of a Binary Search Tree.
19. Program to search a node in a Binary Search Tree.
20. Program to create a Graph using Adjacency Matrix Representation.

COURSE OUTCOMES: At the end of the practical course students will be able to

CO1: Execute Searching and Sorting Techniques using C.
CO2: Execute Linear Data Structures and Non-Linear Data Structures using C.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Statistical Quality Control
Skill Enhancement Course (SEC I)

COURSE CODE: HDS326A | **PPW: 2**
YEAR/SEMESTER: II/III | **NO. OF CREDITS: 2**

COURSE OBJECTIVE: This course aims to provide the concepts of modern quality control techniques, including the design of statistical process control systems and acceptance sampling plans.

UNIT-WISE COURSE OBJECTIVES:

COb1: To learn various statistical tools of quality monitoring.
COb2: To learn the statistical and economical design issues associated with the monitoring tools.

UNIT – I:

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

UNIT – II:

Acceptance sampling plans: Concept of AQL and LTPD. Producers risk and consumer's risk Single and Double sampling plans for attributes and their OC and ASN functions. Design of single and double sampling plans for attributes using Binomial and Poisson distributions.

Prescribed Books:

1. Gupta, S. C., & Kapoor, V. K., Fundamentals of mathematical statistics, Sultan Chand & Sons. New Delhi, 2000.
2. D. C. Montgomery, Introduction to Statistical Quality Control, John Wiley & Son, 2009.

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Reference Books:

1. L. S. Srinath, Reliability Engineering, Affiliated East-West Press 2005.
2. Parimal Mukhopadhyay, Applied Statistics, New Central Book Agency 2000.
3. R.C.Gupta, Statistical Quality Control& Quality Management, 9th Edition, Khanna Publisher 1998.
4. Ramesh Gulati, Maintenance and Reliability Best Practices, Industrial Press2013.
5. M Mahajan, Statistical Quality Control, Dhanpat Rai & Co.(P) Limited 2016.
6. Eugene Grant and Richard Leavenworth, Statistical Quality Control, McGraw Hill Education 2017.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Understand the philosophy and basic concepts of quality improvement, demonstrate the ability to design and interpret control charts for variables and attributes.

CO2: Perform analysis of process capability and measurement system capability.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Java Programming
Skill Enhancement Course (SEC I)

COURSE CODE: HDS326B **PPW: 2**
YEAR/SEMESTER: II/III **NO. OF CREDITS: 2**

COURSE OBJECTIVE: To familiarize the students with concepts of Java Programming.

UNIT-WISE COURSE OBJECTIVES:

COb1: To discuss real-time Java applications, Java Methods and Classes.
COb2: The significance of Inheritance, Packages, Interfaces and Exception Handling are discussed.

UNIT-I: The History and Evolution of Java, A Closer Look at Methods and Classes

The History and Evolution of Java: The Creation of Java, How Java Changed the Internet, The Byte code, The Java Buzzwords. **An Overview of Java:** Object Oriented Programming, A First Simple Program. **Introducing Classes:** Class Fundamentals, Declaring Objects, Introducing Methods, Constructors and Garbage Collection.
A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Recursion, Understanding Static and Introducing final.

UNIT –II: Inheritance, Packages and Interfaces, Exception Handling

Inheritance: Inheritance Basics, Using Super, Creating a Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes.
Packages and Interfaces: Packages, Access Protection, Importing Packages, Interfaces.
Exception Handling: Exception Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses.

Prescribed Book:

1. Java: The Complete Reference, Herbert Schildt, 9th edition, Tata McGraw-Hill, 2014.

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Reference Books:

1. Programming with Java, E.Balaguruswamy, A primer 5th edition, Tata McGraw-Hill,2014.
2. Programming with Java, John R. Hubbard, Second Edition, Schaum's outline Series, Tata McGraw-Hill, 2007.
3. Understanding Object Oriented Programming with Java, Timothy Budd, Pearson Education, Second Edition, 2001.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Outline real-time Java applications, Java Methods and Classes.
CO2: Acquire knowledge on Inheritance, Packages, Interfaces and Exception Handling.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: PC Maintenance
Skill Enhancement Course (SEC I)

COURSE CODE: HDS326C **PPW: 2**
YEAR/SEMESTER: II/III **NO. OF CREDITS: 2**

COURSE OBJECTIVE: To familiarize the students with concepts of PC Maintenance.

UNIT-WISE COURSE OBJECTIVES:

COb1: To identify PC Components, Features, System Design, Motherboards and Bus.
COb2: To correlate the importance of Memory, Power Supplies, Input Devices, Hard Disk Storage, Building or Upgrading Systems and PC Diagnostics, Testing, and Maintenance.

UNIT-I:PC Components, Features, System Design and Motherboards and Buses

PC Components, Features and System Design: What is a PC, Who Controls PC Software, Who Controls PC Hardware, PC Design Guides, System Types, System Components.
Processor Types and Specifications: Microprocessor History, Processor, Processor Socket and Slot Types, Intel Family: Intel P6 (686) Processors, Pentium III, Celeron, Intel Pentium 4 Processors, Pentium 4 Extreme Edition, Intel Core Processors, Others: AMD K6 Processors, AMD K7 Processors, AMD K8 Processors.
Motherboards and Buses: Motherboard Form Factors, Chipsets (Intel Chipsets, North/South Bridge Architecture, Fifth-Generation (P5 Pentium Class) Chipsets, Sixth-Generation (P6 Pentium Pro/II/III Class) Chipsets, Seventh/Eighth-Generation (Pentium 4/D, Core 2, and Core i) Chipsets, Third-Party Chipsets for Intel Processors, Chipsets for AMD Processors), Motherboard Connectors, System Bus Types, Types of I/O Buses.

Practicals:

1. Identifying external ports and interfacing of peripherals (Such as Monitor, Keyboard, Mice, Speakers, Printers and Modem).
2. Identifying PC cards such as memory board, display card, NIC cardand Sound Blaster card.
3. Identifying the ports on cards.

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UNIT-II: Memory, Power Supplies, Input Devices, Hard Disk Storage, Building or Upgrading Systems and PC Diagnostics, Testing, and Maintenance

Memory: Memory Basics, Memory Standards, Memory Modules, Memory Banks.
Power Supplies: The Power Supply, Primary Function and Operation, Power Supply Form Factors, Power Switches, Motherboard Power Connectors.
Input Devices: Keyboards, Optical Mice, Pointing Device Interface Types, Wireless Input Devices.
Hard Disk Storage: Hard Drive Advancements, Form Factors, Basic HDD Components.
Building or Upgrading Systems: System Components, System Assembly and Disassembly, Installing the OS, Troubleshooting New Installations.
PC Diagnostics, Testing, and Maintenance: PC Diagnostics, Diagnostics Software, Peripheral Diagnostics, Operating System Diagnostics, Commercial Diagnostics Software, Free/User Supported Diagnostics, The Boot Process, Booting from Optical or Floppy, PC Maintenance Tools.

Practicals:

1. Interfacing Hard disks.
2. Disassembling and assembling of PC.
3. Preventive maintenance of PC.
5. Understanding of CMOS setup.
6. Loading windows operating system and device drivers.
7. Installation of application software.

Prescribed Book:

1. Upgrading and repairing PCs, Scott Mueller, 20th Edition, QUE (PHI) –2011.

Reference Books:

1. IBM PC Clones by Govindarajalu, 2nd edition, McGraw-Hill education, 2008.
2. PC Upgrade & Repair Black Book by Ron Gilster, Dreamtech Press India Pvt Ltd, Paperback (1), 2001.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Identify PC Components, Features, System Design, Motherboards and Bus.
CO2: Comprehend the importance of Memory, Power Supplies, Input Devices, Hard Disk Storage, Building or Upgrading Systems and PC Diagnostics, Testing, and Maintenance.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Linear Algebra

COURSE CODE: HDS421 **PPW: 5L+1T**
YEAR/SEMESTER: II/IV **NO. OF CREDITS: 5**

COURSE OBJECTIVE: This course is aimed at familiarising students with concepts in modern mathematical subject.

UNIT-WISE COURSE OBJECTIVES:

COb1: To learn concepts in Vector Space and Subspace.
COb2: To acquire knowledge about Row space, Column space, Null space and matrix of Linear Transformation.
COb3: To explain the concepts of Eigen vectors and Eigen values.
COb4: To analyse various concepts of Inner Product and orthogonality.

Unit-I:VECTOR SPACES I

Vector Space and Subspace, Linear combinations, Subspace spanned by a set, Linearly Independent and dependent sets, Basis, The co-ordinate system, The dimension of a vector space. (Chapter 4.1 ,4.3& 4.5)

Unit-II: VECTOR SPACES II

Null space, Column space and Row space of a matrix, Basis and dimensions of Null space, Column space and Row space of a matrix, Rank and rank theorem, Linear Transformations, Kernel and range of Linear Transformations, Matrix of a Linear Transformations. (Chapter 4.2, 4.6, 4.7, 5.1 & 5.2)

Unit-III:EIGEN VALUES AND EIGEN VECTORS

Eigen Values, Eigen Vectors, The characteristic Equation, Diagonalization, Complex Eigen values. (Chapter 5.3,5.4 &5.5)

Unit-IV: INNER PRODUCT OF VECTORS

Inner Product, Length and Orthogonality, Orthogonal set, Gram-Schmidt Process, Orthonormal Basis. (Chapter 6.1 to 6.5)

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Prescribed Text Book:

1. David C Lay, Linear Algebra and its Applications, Pearson Publications, 4th Edition, 2012.

Reference Books:

1. Introduction to Linear Algebra, S Lang, Springer Publications, 2nd Edition, 1980.
2. Linear Algebra and its Applications, Gilbert Strang, Cengage Learning5thEdition, 2014.
3. Linear Algebra, Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence; Pearson India Publications,4th Edition, 2011.
4. Linear Algebra, Kuldeep Singh; Oxford University Press, ISBN-13:1stEdition, 2013.
5. Linear Algebra, Sheldon Axler; Springer Publications,3rd Edition, 2016.

COURSE OUTCOMES: After completion of course students will be able to

CO1: Interpret properties of Vector Space and Subspace.
CO2: Compute and calculate Rank and Nullity.
CO3: Evaluate eigenvectors and Eigen values.
CO4: Summarise and synthesise the concepts in Inner Product spaces.

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Accredited with 'A' grade by NAAC
PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Linear Algebra Practicals

COURSE CODE: HDS421P | **PPW: 2**
YEAR/SEMESTER: II/IV | **NO. OF CREDITS: 1**

COURSE OBJECTIVE: Linear Algebra course will enable students to acquire further skills in the techniques as well as understanding of the principles underlying the subject.

COb1: To analyse the solutions of systems of equations using the matrix methods.
COb2: To acquire knowledge on matrices with linear transformations, Eigen values and Eigen vectors.

UNIT I

1. Let H be the set of all vectors of the form $\begin{bmatrix} -2t \\ 5t \\ 3t \end{bmatrix}$. Find a vector V in R^3 such that H=span {V}.Why does this show that H is a subspace of R^3?
2. For what values of h is V_3 in the span$\{v_1,v_2\}$. Also find for what value of $\{v_1,v_2,v_3\}$ is linearly dependent. Justify your answer.
$$v_1=\begin{bmatrix} 1 \\ -3 \\ 2 \end{bmatrix}, v_2=\begin{bmatrix} -3 \\ 9 \\ -6 \end{bmatrix}, v_3=\begin{bmatrix} 5 \\ -7 \\ h \end{bmatrix}$$
3. Find the value of h for which the vectors $v_1=\begin{bmatrix} 1 \\ -2 \\ -4 \end{bmatrix}, v_2=\begin{bmatrix} -3 \\ 7 \\ 6 \end{bmatrix}, v_3=\begin{bmatrix} 2 \\ 1 \\ h \end{bmatrix}$ are linearly dependent.
4. Let $v_1=\begin{bmatrix} 1 \\ -2 \\ 3 \end{bmatrix}, v_2=\begin{bmatrix} -2 \\ 7 \\ -9 \end{bmatrix}$. Determine if the set $\{v_1, v_2\}$ is a basis for R^3. Is it a basis for R^2?
5. The set $B=\{1+t^2, t+t^2, 1+2t+t^2\}$ is a basis for P_2. Find the coordinate vector of $P(t)=1+4t+7t^2$ relative to the basis B.
6. Find the dimension of the subspace H of R^2 spanned by $\begin{bmatrix} 1 \\ -5 \end{bmatrix}, \begin{bmatrix} -2 \\ 10 \end{bmatrix}, \begin{bmatrix} -3 \\ 15 \end{bmatrix}$

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UNIT II

7. Find bases and dimensions of Nul A and Col AFor :A=$\begin{bmatrix} 1 & 2 & 3 & -4 & 8 \\ 1 & 2 & 0 & 2 & 8 \\ 2 & 4 & -3 & 10 & 9 \\ 3 & 6 & 0 & 6 & 9 \end{bmatrix}$

8. Find bases and dimensions of Nul A and Col A

For A=$\begin{bmatrix} 2 & -1 & 1 & -6 & 8 \\ 1 & -2 & -4 & 3 & -2 \\ -7 & 8 & 10 & 3 & -10 \\ 4 & -5 & -7 & 0 & 4 \end{bmatrix}$

9. Explain your answer while solving the following:
   (i) If a 7X5 matrix A has rank 2, find dim NulA, dim Row A and rank A^T.
   (ii) If A is a 7X5 or 5X7 matrix what is the largest possible rank A?
   (iii) Could a 6X9 matrix have a two dimensional null space?
   (iv) If A is a 3X7 matrix, what is the smallest possible dimension of Nul A?

10. Define T: $P_2 \rightarrow R^2$ by T(p)=$\begin{bmatrix} p(0) \\ p(1) \end{bmatrix}$. (a) Show that T is a linear transformation.

    b) Find a polynomial p in P_2 that spans the kernel of T. (c) Describe the Range of T.

11. Define T: $P_2 \rightarrow R^3$ by T(p)=$\begin{bmatrix} p(-1) \\ p(0) \\ p(1) \end{bmatrix}$

    a) Find the image of p(t) = 5+3t
    b) Show that T is a linear transformation.
    c) Find the matrix for T relative to the basis $\{1, t, t^2\}$ for P_2 and the standard basis of R^3

12. a) Find $T(a_0+a_1t+a_2t^2)$, if T is the linear transformation from P_2 to P_2 whose matrix relative to $B=\{1, t, t^2\}$ is:

$$[T]_B = \begin{bmatrix} 3 & 4 & 0 \\ 0 & 5 & -1 \\ 1 & -2 & 7 \end{bmatrix}$$

    b) Let $B=\{b_1, b_2, b_3\}$ be a basis for a vector space V. Find $T(4b_1-3b_2)$ when T is a linear transformation from V to V whose matrix relative to B is : $[T]_B = \begin{bmatrix} 0 & 0 & 1 \\ 2 & 1 & -2 \\ 1 & 3 & 1 \end{bmatrix}$

UNIT III

13. a) If $\lambda = 5$ is an Eigen value of A=$\begin{bmatrix} 0 & -3 & 1 \\ 3 & 0 & 5 \\ 2 & 2 & 6 \end{bmatrix}$

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b) Is $\begin{bmatrix} 3 \\ -2 \\ 1 \end{bmatrix}$ an Eigen vector of A= $\begin{bmatrix} -4 & 3 & 3 \\ 2 & -3 & -2 \\ -1 & 0 & -2 \end{bmatrix}$?

If so find the Eigen Value.

14. a) Is $\lambda = 4$ an Eigen value of A = $\begin{bmatrix} 3 & 0 & -1 \\ 2 & 3 & 1 \\ -3 & 4 & 5 \end{bmatrix}$?

If so find the corresponding Eigen vector.

b) Is $\lambda = 3$ an Eigen value of A = $\begin{bmatrix} 4 & 0 & -1 \\ 3 & 0 & 3 \\ 2 & -2 & 5 \end{bmatrix}$?

If so find the corresponding Eigen vector.

15. Find the characteristic equation and Eigen values of A = $\begin{bmatrix} 5 & -2 & 6 & -1 \\ 0 & 3 & -8 & 0 \\ 0 & 0 & 5 & 4 \\ 0 & 0 & 0 & 1 \end{bmatrix}$.

16. If $A = PDP^{-1}$ and P= $\begin{bmatrix} 5 & 7 \\ 2 & 3 \end{bmatrix}$, D= $\begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$ find A^4.

17. Diagonalize the matrix A= $\begin{bmatrix} 2 & -2 & -2 \\ 3 & -3 & -2 \\ 2 & -2 & -2 \end{bmatrix}$

18. Find the Eigen values and a basis for each eigen space in C^2 for the following:
A= $\begin{bmatrix} 1 & -2 \\ 1 & 3 \end{bmatrix}$.Also find an invertible matrix P and a matrix C such that $A = PCP^{-1}$

UNIT IV

19. If w= $\begin{bmatrix} 3 \\ -1 \\ -5 \end{bmatrix}$, x= $\begin{bmatrix} 6 \\ -2 \\ 3 \end{bmatrix}$ then compute w.w,x.w, $\left(\frac{x.w}{w.w}\right)w$, and $\left(\frac{w.x}{x.x}\right)x$.

20. Let u= $\begin{bmatrix} 2 \\ -5 \\ -1 \end{bmatrix}$ and v= $\begin{bmatrix} -7 \\ -4 \\ 6 \end{bmatrix}$ compute and compare u.v, $\|u\|^2, \|v\|^2, \|u+v\|^2$

21. For vectors u,v in R^n find i) $\|u+v\|^2 + \|u-v\|^2$ ii) $\|u+v\|^2 - \|u-v\|^2$.

22. Determine which of the following sets of vectors are orthogonal:

i) $\begin{bmatrix} -1 \\ 4 \\ -3 \end{bmatrix}, \begin{bmatrix} 5 \\ 2 \\ 1 \end{bmatrix}, \begin{bmatrix} 3 \\ -4 \\ -7 \end{bmatrix}$ ii) $\begin{bmatrix} 3 \\ -2 \\ 1 \\ 3 \end{bmatrix}, \begin{bmatrix} -1 \\ 3 \\ -5 \\ 4 \end{bmatrix}, \begin{bmatrix} 3 \\ 8 \\ 7 \\ 0 \end{bmatrix}$

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23. Show that $u_1=\begin{bmatrix}1\\0\\1\end{bmatrix}$, $u_2=\begin{bmatrix}-1\\4\\1\end{bmatrix}$, $u_3=\begin{bmatrix}2\\1\\-2\end{bmatrix}$ is an orthogonal basis of R^3. Express $x=\begin{bmatrix}8\\-4\\-3\end{bmatrix}$ as a linear combination of u_1, u_2, u_3.

24. Let $y=\begin{bmatrix}2\\6\end{bmatrix}$ and $u=\begin{bmatrix}7\\1\end{bmatrix}$. Write y as the sum of a vector in span {u} and a vector orthogonal to u.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Demonstrate principle of matrix algebra to linear transformations.
CO2: Evaluate computational procedures involving Linear Algebra.

NOTE: Use MATLAB for Practicals in Unit III and Unit IV

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Applied Statistics

COURSE CODE: HDS422 **PPW: 4**
YEAR/SEMESTER: II/IV **NO. OF CREDITS: 4**

COURSE OBJECTIVE: This course aims to understand how to design experiments and conduct surveys efficiently for practical applications in their current or future employment.

UNIT-WISE COURSE OBJECTIVES:

COb1: To learn techniques in survey sampling with Simple Random Sampling practical applications in daily life this would be beneficial for the further research.
COb2: To learn techniques in survey sampling with Stratified and Systematic Random Sampling practical applications in daily life this would be beneficial for the further research.
COb3: Demonstrate an application of one - way and two - way analysis of variance.
COb4: Obtain the knowledge about application of Design of Experiments.

UNIT-I:

Sampling: Census and sample survey design. Non-probability sampling methods- uses and limitations, sampling frames, sampling fraction. Simple random sampling - Estimators of means and variances by SRSWR and SRSWOR. Merits and Demerits of Simple Random Sampling.

UNIT-II:

Stratified Random Sampling- Estimators of means and variances. Cost functions. Proportional and optimal allocations. Comparison of Stratified Random Sampling with SRSWOR. Gain in efficiency due to stratification. Limitations of stratified sampling.

Systematic Sampling - Estimators for means and variances. Merits and Demerits of Systematic sampling. Description of cluster sampling and of multi-stage sampling. Limitations.

UNIT-III:

Analysis of Variance (ANOVA): Concept of Gauss-Mark off linear model with examples, statement of Cochran's theorem,ANOVA – one-way, two-way classifications with one observation per cell. Expectation ofVarious sums of squares and their Statistical analysis.

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UNIT-IV:

Design of Experiments: Importance and applications of design of experiments. Principles of experimentation. Analysis of Completely Randomized Design (C.R.D), Randomized Block Design (R.B.D) and Latin Square Design (L.S.D) including one missing observation, expectation of various sum of squares. Comparison of the efficiencies of the above designs.

Prescribed Books:

1. V. K. Kapoor and S. C. Gupta, Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi, 2000.
2. V.K.Rohatgi and A.K.Md.Ehsanes Saleh, An Introduction to probability and statistics, Wiley series, 2001.
3. Parimal Mukhopadhyay, Mathematical Statistics, New Central Book agency, 2000.

Reference Books:

1. Hoel P. G., Introduction to mathematical statistics, Asia Publishing house, 1966.
2. Sanjay Arora and Bansi Lal, New Mathematical Statistics, Satya Prakashan, NewDelhi, 1989.
3. Hogg and Craig, Introduction to Mathematical statistics, Printis Hall, 2019.
4. Siegal S. and Sidney, Non-parametric statistics for Behavioral Science, McGraw Hill, 1956.
5. GibbonsJ.D and Subhabrata Chakraborti, Nonparametric Statistical Inference, Marcel Dekker, 2003.
6. Conover, Practical Nonparametric Statistics, Wiley series, 1998.
7. Mood AM, Graybill F A, Boe's DC., Introduction to theory of statistics, TMH, 1974.
8. Paramiteya mariyua parameteyaparikshalu. Telugu Academy.
9. K.V.S. Sarma, Statistics Made simple do it yourself on PC, PHI, 2010.
10. Gerald Keller, Applied Statistics with Microsoft excel, Duxbury, Thomson Learning, 2001.
11. Levin, Stephan, Krehbiel, Berenson, Statistics for Managers using Microsoft Excel, 4th edition. Pearson Publication, 2005.
12. Hogg, Tanis, Rao. Probability and Statistical Inference, 7th edition, Pearson Publication, 2005.
13. Milton and Arnold (fourth Edition), Introduction to Probability and statistics, Tata McGraw Hill Publication, 2014.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Understand distinctive features of Simple Random Sampling schemes and its applications in real life.

CO2: Understand distinctive features of Stratified and Systematic Random Sampling schemes and its applications in real life.

CO3: Assess ANOVA for one-way, two –way classification, fixed effect models with equal, number of observations per cell in real time problems.

CO4: Analyze and interpret the data using Design of Experiments.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Advanced Optimization Methods for Analytics

COURSE CODE: HDS423 **PPW: 4**
YEAR/SEMESTER: II/IV **NO. OF CREDITS: 4**

COURSE OBJECTIVE: This course aims to provide the students with knowledge on applying various optimization techniques, which can help make decisions for practical problems in industries.

UNIT-WISE COURSE OBJECTIVES:

COb1: Understand the sequence of jobs on machines and simulation.
COb2: Understand the development of project network diagram - work out numerical problems.
COb3: To understand probabilistic models are employed in countless applications in all areas of science.
COb4: Analyze the possible outcomes of situations ranging from card games and sports to strategic price fixing, negotiation, group cooperation.

UNIT-I:

Sequencing: Processing n Jobs through 2 and 3 Machines, Processing n Jobs through m Machines and Processing 2 Jobs on n Machines.

Simulation: process of simulation, applications of simulation to different real time problems,Monte- Carlo method of simulation and Applications to queuing problems.

UNIT-II:

Network Analysis: Network fundamentals – scheduling the Activities – Fulkerson's rule – CPM earliest and latest times – determination of ES and EF in the forward pass – LS and LF in backward pass determination of critical path.

PERT- probabilistic models, calculation of CP, resources analysis and allocation.

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UNIT-III:

Queuing theory: concepts of queue/ waiting line – general structure of a queuing system – operating characteristics of queues, deterministic queuing models – probabilistic queuing model single channel queuing model – Poisson arrival and exponential service times with finite and infinity population.

UNIT-IV:

Game Theory : Concepts, Saddle point, Dominance, Zero-sum game, Two, three and more persons games, analytical method of solving two-persons zero sum game, graphical solutions for (m x 2) and (2 x n) games. Linear Programming approach for Game Theory.

Prescribed Books:

1. Kranti Swaroop, P.K.Gupta and ManMohan, Operations Research, 8th Revised Edition, Sultan Chand & Sons , New Delhi, India : 2000.
2. S D Sharma, Operations Research, Kedarnath Ramnath & Co. Meerut 2017.
3. Hamdy A. Taha, Operations Research: An Introduction, 10th Edition, Pearsons Education Limited 2018.

Reference Books:

1. Gass, Linear Programming Methods and Applications, 5th Edition Paper back, Mc Graw Hill 2011.
2. J. K. Sharma, Operation Research: theory and applications, 6th Edition, India Trinity Press 2016.
3. K V Mittal and C Mohan, Optimizations methods in operations research and systems analysis, India New Age International 2016.
4. Pradeep Prabhakar Pai, Operations research : principles and practice, India Oxford 2012.
5. Wayne L. Winston, Operations Research, 4th Edition, Thomson Press, India 2004.
6. K Rajagopal, Operations Research, India PHI learning Private Limited 2012.
7. Frederick S. Hiller, Introduction to Operations research, India Tata McGraw Hill Education Pvt Ltd 2010.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Understand the usage of Sequencing Jobs and Simulation for Solving Business Problems.

CO2: Formulate Network models for service and manufacturing systems and apply operations research techniques and algorithms to solve these Network problems.

CO3: Understand basic characteristic features of a queuing system and acquire skills in analyzing queuing models.

CO4: Demonstrate solution methods including graphs and linear programming to analyze and solve the Two-person, zero-sum games.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Data Analysis Practical using Python and TORA II

COURSE CODE: HDS422P **PPW: 2**
YEAR/SEMESTER: II/IV **NO. OF CREDITS: 1**

COURSE OBJECTIVE: This course aims to provide analytical knowledge to apply the design of experiments and optimization techniques for solving large-scale problems using Statistical Softwares.

COb1: Perform inference on the design of the experimental model using Python.
COb2: Enumerate the fundamental knowledge of solving networking models, game theory, and queuing theory problems using TORA Software.

1. ANOVA for One Way using Python.
2. ANOVA for Two Way using Python.
3. Completely Randomized Design using Python.
4. Randomized Block Design using Python.
5. Network Analysis -Shortest Route using TORA.
6. Project Planning using TORA.
7. Queuing Analysis using TORA.
8. Zero-sum game theory problems using TORA.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Understand the process of writing code to solve the design of the experiment's real-life problems using Python.
CO2: Understand how numerical optimization techniques can be used in data modelling and how those models can be implemented in TORA.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Big Data Analytics

COURSE CODE: HDS424 **PPW: 4**
YEAR/SEMESTER: II/IV **NO. OF CREDITS: 4**

COURSE OBJECTIVE: To impart knowledge in students with the concepts of big data, handling huge data for analytics.

UNIT-WISE COURSE OBJECTIVES:

COb1: To inculcate knowledge on big data and technologies for handling big data.
COb2: To demonstrate the concepts of Hadoop ecosystem and NoSQL database.
COb3: To inculcate knowledge on MapReduce fundamentals, HBase and big data stack.
COb4: To illustrate the concepts of big data analytics usage in social media and text mining.

UNIT – I: Getting an overview of Big Data and Introducing Technologies for Handling Big Data

Getting an overview of Big Data: Introduction to Big Data, Structuring Big Data, Types of Data, Elements of Big Data, Big Data Analytics, Advantages of Big Data Analytics.
Introducing Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data, Introducing Hadoop, HDFS and MapReduce, Hadoop Functionality, Cloud Computing and Big Data, Features of Cloud Computing, Cloud Deployment Models, Cloud Services for Big Data, Cloud Providers in Big Data Market.

UNIT – II: Understanding Hadoop Ecosystem and NoSQL Data Management

Understanding Hadoop Ecosystem: Hadoop Ecosystem, Hadoop Distributed File System, HDFS Architecture, Concept of Blocks in HDFS Architecture, Namenodes and Datanodes, Features of HDFS. MapReduce. Introducing HBase - HBase Architecture, Regions, Storing Big Data with HBase, Combining HBase and HDFS, Features of HBase. Hive, Pig and Pig Latin, Sqoop, Zookeeper, Flume, Oozie.
NoSQL Data Management: Introduction to NoSQL, Benefits and Challenges of NoSQL, Characteristics of NoSQL, History of NoSQL, Types of NoSQL Data Models, Key Value Data Model, Column-Oriented Data Model, Document Data Model, Graph Databases, Schema-Less Databases, Materialized Views, Distribution Models, CAP Theorem,Sharding.

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UNIT- III: Understanding MapReduce Fundamentals and HBase, Understanding Big Data Technology Foundations

Understanding MapReduce Fundamentals and HBase: The MapReduce Framework, Exploring the features of MapReduce, Working of MapReduce, Techniques to optimize MapReduce Jobs, Hardware/Network Topology, Synchronization, File system, Uses of MapReduce, Role of HBase in Big Data Processing- Characteristics of HBase.
Understanding Big Data Technology Foundations: Exploring the Big Data Stack, Data Sources Layer, Ingestion Layer, Storage Layer, Physical Infrastructure Layer, Platform Management Layer, Security Layer, Monitoring Layer, Visualization Layer, Virtualization and Big Data, Virtualization Approaches.

UNIT – IV: Understanding Analytics and Big Data, Social Media Analytics and Text Mining

Understanding Analytics and Big Data: Comparing Reporting and Analysis, Reporting, Analysis, Analytic Process, Types of Analytics-Basic Analytics, Advanced Analytics, Operationalized Analytics, Monetized Analytics, Characteristics of Big Data Analytics, Points to consider during Analysis- Frame the Problem Correctly, Statistical Significance or Business Importance, Making Inferences versus Computing Statistics, Developing an Analytic Team- Skills Required for an Analyst, Convergence of IT and Analytics. Understanding Text Analytics.
Social Media Analytics and Text Mining: Introducing social media, Key elements of social media, Text Mining, Understanding Text Mining Process, Sentiment Analysis.

Prescribed Book:

1. BIG DATA, Black BookTM, DT Editorial Services, DreamTech Press, 1st Edition ,2016.

Reference Books:

1. BIG DATA and ANALYTICS, Seema Acharya, Subhashini Chellappan, Wiley publications, 2nd Edition, 2015.
2. BIG DATA- Principles and Best Practices of Scalable Real-Time Systems, Nathan Marz and James Warren, 1st Edition, 2015.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Acquire knowledge on big data and technologies for handling big data.
CO2: Acquire knowledge on Hadoop ecosystem and NoSQL database.
CO3: Comprehend MapReduce fundamentals, HBase and big data stack.
CO4: Acquire knowledge on the usage of big data analytics in social media and text mining.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Big Data Analytics Lab

COURSE CODE: HDS424P **PPW: 2**
YEAR/SEMESTER: II/IV **NO. OF CREDITS: 1**

COURSE OBJECTIVE: To impart knowledge on Hadoop ecosystem and the usage of Map Reduce applications on big data.

COb1: To inculcate knowledge on the installation of Hadoop and Map Reduce applications.
COb2: To demonstrate the concepts of Pig Latin scripts and Hive.

1. Installation of Hadoop.
2. Creating a directory in HDFS at given path(s).
3. List the contents of a directory.
4. Upload and Download a file in HDFS.
5. See contents of a file.
6. Copy file from source to destination.
7. Move file from source to destination.
8. Remove a file or directory in HDFS.
9. Display last few lines of a file.
10. Word Count Map Reduce Program.
11. Map Reduce program to analyze time-temperature statistics and generate report with min/max temperature.
12. Implementation of Matrix Multiplication with Hadoop Map Reducewith Hadoop Map Reduce.
13. Installing and running Pig, practice some Pig commands.
14. Pig Latin scripts to sortgroup, join, project and filter data.
15. Write Pig Latin scripts using eval functions to analyze your data.
16. Write Pig Latin scripts using math functions to analyze your data.
17. Write Pig Latin scripts using string functions to analyze your data.
18. Installing and running Hive, practice some Hive commands.
19. Hive to create Databases and Tables.
20. Hive to create Views, Functions and Indexes.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Implement the installation of Hadoop, Map Reduce applications.
CO2: Acquire knowledge and implement Pig Latin scripts and Hive.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Computer Networks

COURSE CODE: HDS425 **PPW: 4**
YEAR/SEMESTER: II/IV **NO. OF CREDITS: 4**

COURSE OBJECTIVE: To familiarize the students with concepts of Computer Networks.

UNIT-WISE COURSE OBJECTIVES:

COb1: To discuss the concepts of OSI/ISO reference model and TCP /IP reference model and IP addressing system.
COb2: To demonstrate Transmission Media, Multiplexing and Error Detection.
COb3: To explain the concepts of Data Link Control, HDLC Protocol, and Local Area Networks.
COb4: To illustrate the concepts of Switching, Networking & Internetworking Devices and Routing Algorithms.

UNIT–I: Introduction and IP Addressing System

Introduction: Data Communication Components, Line Configuration, Topologies, Transmission Mode, Categories of Networks, OSI/ISO Reference Model–Layered Architecture, Functions of Layers, TCP/IP Reference Model.
IP Addressing System: Class A, Class B, Class C, Class D & Class E (Range and Usage).

UNIT–II: Transmission Media, Multiplexing and Error Detection

Transmission Media: Guided Media–Twisted Pair Cable, Coaxial Cable, Optical Fiber, Unguided Media– Satellite Communication, and Cellular Telephony.
Multiplexing: Frequency–Division Multiplexing, Time–Division Multiplexing.
Error Detection: Types of Errors, VRC, LRC, CRC, Checksum.

UNIT – III: Data Link Control, HDLC Protocol and Local Area Networks

Data Link Control: Line Discipline–ENQ/ACK, Poll/Select, Flow Control–Stop-and-Wait, Sliding Window, Error Control–Stop-and-Wait ARQ, Sliding Window ARQ, Go-Back-n ARQ, Selective-Reject ARQ.
HDLC Protocol: HDLC and HDLC Frame Structure.
Local Area Networks: Introduction to IEEE 802, Ethernet- CSMA/CD, Implementation, Token Ring,-Token Passing, Implementation.

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UNIT–IV: Switching, Networking and Internetworking Devices, Routing Algorithm

Switching: Circuit Switching, Packet Switching, Message Switching.
Networking and Internetworking Devices: Repeaters, Bridges, Routers, Gateways, Brouters, Switches.
Routing Algorithms: Distance Vector Routing Algorithm, Link State Routing Algorithm.

Prescribed Book:

1. Data Communication and Networking (2e Update), Behrouz A. Forouzan, 2002.

Reference Books:

1. Data and Computer Communications, WilliamStallings, Prentice Hall, 8th Edition,2006.
2. Computer Networks, S.S. Shinde,New Age International (P) LtdPublishers,2nd Edition, 2009.
3. Computer Networks, Andrew S. Tanenbaum, David J Wetherall,Pearson Education, 5th Edition, 2012.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Comprehend concepts of OSI/ISO reference model and TCP /IP reference model and IP addressing system.
CO2: Decipher the Transmission Media, Multiplexing and Error Detection.
CO3: Elucidate the concepts of Data Link Control, HDLC Protocol, and Local Area Networks.
CO4: Exemplify the concepts of Switching, Networking & Internetworking Devices and Routing Algorithms.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Six Sigma and Reliability Theory
Skill Enhancement Course (SEC II)

COURSE CODE: HDS426A **PPW: 2**
YEAR/SEMESTER: II/IV **NO. OF CREDITS: 2**

COURSE OBJECTIVE: This course aims to provide how Six Sigma and Reliability theory can be effectively applied in manufacturing industries to improve the process and product quality.

UNIT-WISE COURSE OBJECTIVES:

COb1: Ability to put the knowledge of the Six Sigma concepts to process improvement.
COb2: Demonstrate the approaches and techniques to assess and improve process and/or product quality and reliability.

UNIT – I:

Six Sigma: Introduction, Six Sigma History and Application, Basic Six Sigma Concepts, Overview, basic Six Sigma Concepts, Quality- Critical to Quality Characteristics, Roles and responsibilities in Six Sigma Implementation, DMAIC / DMDAV methodology, Design for Six Sigma. Natural tolerance limits and specification limits, process capability index.

UNIT – II:

Reliability: Introduction. Hazard function, Exponential distribution as life model, its memory-less property, Reliability function and its estimation, System reliability - series, parallel and k out of n systems and their reliabilities.

Prescribed Books:

1. Michael L. George, John Maxey, The Lean Six Sigma Pocket Tool book, McGraw Hill Publication, 2005.
2. S.K.Sinha, Reliability and life testing, Wiley Eastern, 1987.
3. Michael L. George, David Rowlands, Bill Kastle, What is Lean Six Sigma, 1st Edition, McGraw Hill Education, 2005.

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Reference Books:

1. Thomas Pyzdek, The Six Sigma Handbook, The Complete Guide for Greenbelts, Blackbelts, and Managers at All Levels, Revised and Expanded Edition 5th Edition, 2018.
2. Thomas Pyzdek, The Six Sigma Handbook Revised and Expanded, McGraw Hill 2003.
3. Mario Vianello, PRODUCT RELIABILITY DESIGN 6, Managerial considerations and Six Sigma, Kindle Edition 2017.
4. Howard S. Gitlow , Richard J. Melnyck , David M. Levine, A Guide to Six Sigma and Process Improvement for Practitioners and Students: Foundations, DMAIC, Tools, Cases, and Certification Hardcover, Second Edition, 2015.
5. L.S.Srinath, Reliability Engineering, Affiliated East-West Press 2005.
6. Ramesh Gulati, Maintenance and Reliability Best Practices, Industrial Press, 2013.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Develop conceptual and practical understanding of six sigma, benefits/ requirements and tools used.

CO2: Attain the basic techniques of quality improvement, fundamental knowledge of reliability theory.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2021-2022)
COURSE NAME: Web Programming
Skill Enhancement Course (SEC II)

COURSE CODE: HDS426B **PPW: 2**
YEAR/SEMESTER:II/IV **NO. OF CREDITS: 2**

COURSE OBJECTIVE: To familiarize the students with concepts of web Programming.

UNIT-WISE COURSE OBJECTIVES:

COb1: To discuss HTML tags.
COb2: To implement the concepts of JavaScript.

UNIT-I:HTML Tags

HTML Introduction, Structure of HTML, Tags, Physical and Logical Tags, Text Formatting Tags, Image Tag, Multimedia Tags, Heading Tags, Lists Tag, Hyperlink Tag, Table Tags, Form Tags, Frame Tags.

UNIT-II: Basics of JavaScript

JavaScript Introduction, JavaScript benefits, JavaScript Basics, Data Types, Dialog Boxes, Statements, Arrays, Built-in Objects (String, Math, Document, Navigator and Window).

Prescribed Book:

1. Web Programming Building Internet Applications,Chris Bates,Wiley,Second Edition, 2007.

Reference Books:

1. Internet and World Wide Web: How toprogram,Harvey M.Dietel, Paul J.Dietel, T.R.Nieto, Pearson,5th edition, 2012.
2. HTML Black Book, comprehensive problem solver, Steven Holzer –Dream Tech Press, Reprint Edition, 2008.

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COURSE OUTCOMES: At the end of the course students will be able to

CO1: ApplyHTML tags.
CO2: Elucidate concepts of JavaScript.

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PROGRAM NAME:B.Sc(Honours) in Data Science
(w.e.f. 2021-2022)
COURSE NAME: PHP with MySQL
Skill Enhancement Course (SEC II)

COURSE CODE: HDS426C **PPW: 2**
YEAR/SEMESTER:II/IV **NO. OF CREDITS: 2**

COURSE OBJECTIVE: To familiarize the students with concepts of PHP with MySQL.

UNIT-WISE COURSE OBJECTIVES:

COb1: To explain concepts of PHP.
COb2: To be able to understand the concepts of handling HTML forms with PHP and MySQL database.

UNIT – I: Introduction to PHP, Decisions, Loops, Strings, Arrays and Functions

Introducing PHP: What is new in PHP 5.3. Creating your first script. PHP Language Basics – Using variables, Understanding Data Types, Operators and Expressions, Constants.
Decisions and Loops – Making Decisions, Doing Repetitive Tasks with Looping, Mixing Decisions and Looping with HTML.
Strings – Creating and Accessing Strings, Formatting Strings.
Arrays – Creating Arrays, Accessing Array Elements, Looping Through Arrays with for-each, Manipulating Arrays.
Functions –Function, Calling Functions, Writing your own Functions, Writing Recursive Functions.

UNIT – II: Handling HTML Forms with PHP and Introducing Databases and SQL

Handling HTML Forms with PHP – How HTML form works, Capturing Form Data with PHP.
Introducing Databases and SQL – Deciding How to Store data and perform database operations. Setting Up MySQL, A Quick Play with MySQL, Connecting MySQL from PHP. Retrieving Data from MySQL with PHP –Retrieving Data with SELECT, Creating a Member Record Viewer. Manipulating MySQL Data with PHP – Inserting, Updating, and Deleting, building a member registration application.

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Prescribed Book:

1. Beginning PHP 5.3, Matt Doyle, (Wrox – Wiley Publishing), 2010.

Reference Books:

1. PHP and MySQL by Example, Ellie Quigley, Pearson Edition, Inc.,2009. (Latest Print).
2. Murach's PHP and MySQL, Joel Murach, Ray Harris, Mike Murach & Associates Inc, 3rd Edition, 2017.
3. PHP & MySQL: The Missing Manual, Brett McLaughlin, O'Reilly, 2nd Edition, 2012.
4. PHP and MySQL Web Development,Luke Welling, Laura Thomson, Addison-Wesley, 5th Edition, 2016.
5. Beginning PHP and MySQL from Novice to Professional, W. Jason Gilmore, Apress, 4th Edition, 2010.
6. Expert PHP and MySQL,Andrew Curioso, Ronald Bradford, Patrick Galbraith, Wrox-Wiley Publishinginc., 2010.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Implement PHP concepts.
CO2: Illustrate concepts of handling HTML forms with PHP and MySQL database.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: Numerical Analysis

COURSE CODE: HDS 521A **PPW: 5L+1T**
YEAR/SEMESTER: III/V **NO. OF CREDITS: 5**

COURSE OBJECTIVE: The main objective of this course is to provide students with an introduction to the field of Numerical Analysis.

UNIT-WISE COURSE OBJECTIVES:

COb1: To solve the equations of one variable.
COb2: To solve Interpolating polynomials and values.
COb3: To fit curves to experimental data and obtain derivative, integration of a function using Numerical techniques
COb4: To analyse the solutions of differential equations using Numerical methods.

Unit – I SOLUTIONS OF EQUATIONS IN ONE VARIABLE (20Hrs)
Solutions of Equations in One Variable: The Bisection Method, The Iteration Method, The Method of False Position, Newton's Method, Muller's Method.

(Chapters: 2.1 to 2.5 & 2.8)

Unit – II INTERPOLATION (20Hrs)
Interpolation and Polynomial Approximation: Interpolation with equal spacing: Finite Differences, Differences of Polynomials, Newton's formulae for Interpolation, Gauss's central differences formulae, Stirling's formula, Interpolation with unequal spacing: Lagrange's Interpolation Polynomial, Divided Differences,Newton's General Interpolation formula, Inverse Interpolation.

(Chapters: 3.3,3.5,3.6, 3.7[3.7.1, 3.7.2], 3.9[3.9.1], 3.10[3.10.1] & 3.11)

Unit – III CURVE FITTING (20Hrs)
Curve Fitting: Least Square Curve Fitting: Fitting a Straight Line, Nonlinear Curve Fitting. Numerical Differentiation. Numerical Integration: Newton's Cotes Integration Formula, Trapezoidal Rule, Simpson's 1/3rd-Rule, Simpson's 3/8th-Rule, Boole's and Weddle's Rule.

(Chapters: 4.1, 4.2[4.2.1,4.2.4 &4.2.5],6.2, 6.4[6.4.1 to 6.4.4])

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Unit -IV NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS (15Hrs)
Numerical Solutions of Ordinary Differential Equations: Taylor's Series Method, Picard's Method, Euler's Methods, Runge Kutta Methods.

(Chapters: 8.1 to 8.5)

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Calculate the solutions of equations in one variable.
CO2: Evaluate Interpolating polynomials and values.
CO3: Design curves to experimental data and obtain derivative, integration of a function using Numerical techniques
CO4: Compute the solutions of differential equations using Numerical methods.

Prescribed Book :

S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, 5th Edition, 2010

Reference Books:

1. Richard L. Burden and J. Douglas Faires, Numerical Analysis, 9th Edition, Cengage Learning, Inc; 2010
2. M K Jain, S R K Iyengar and R K Jain, Numerical Methods for Scientific and Engineering computation, New Age International Pvt Ltd Publishers; 3rd edition, 1996
3. B. Bradie, A Friendly introduction to Numerical Analysis, Pearson India; 1st edition, 2007

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: Integral Transforms

COURSE CODE: HDS 521B **PPW: 5L+1T**
YEAR/SEMESTER: III/V **NO. OF CREDITS: 5**

COURSE OBJECTIVE: The main aim of this course is to expose Students to Integral Transforms and its Applications.

UNIT-WISE COURSE OBJECTIVES:

COb1: To learn concepts of Laplace Transforms.
COb2: To acquire knowledge about Inverse Laplace Transformations.
COb3: To apply Laplace Transforms to ordinary differential equations & Partial differential equations.
COb4: To analyse and apply Fourier Transforms.

UNIT – I LAPLACE TRANSFORMATIONS (20Hrs)

Intergal transform, Laplace Transforms, Linearity property of Laplace transformation, Piecewise continuous function, Existence of Laplace transform(statement), Functions of exponential order, A function of class A, First translation theorem, Second translation theorem, Change of scale property, Laplace transforms of derivatives and integrals, Multiplication by powers of t, Division by t, Evaluation of integral, Periodic functions and Gamma Function.

(Chapter: 1)

UNIT – II INVERSE LAPLACE TRANSFORMATIONS (15Hrs)

Inverse Laplace Transform, Linearity property, First translation theorem, Second translation theorem, Change of scale property, Inverse Laplace Transform of derivatives, Inverse Laplace Transform of integrals, Multiplication by powers of p, Division by powers of p, Convolution definition, Convolution theorem, Heaviside's expansion formula, Beta function.

(Chapter: 2 [2.1 to 2.17])

UNIT – III APPLICATIONS OF LAPLACE TRANSFORMATIONS TO SOLUTIONS OF DIFFERENTIAL EQUATIONS (20Hrs)

Solutions of ordinary differential equations with constant coefficient, Solutions of ordinary differential equations with variable coefficient, Solutions of simultaneous ordinary differential equations, Solutions of Partial differential equations.

(Chapter:3[3.1 to 3.4])

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UNIT – IV FOURIER TRANSFORMS AND FINITE FOURIER TRANSFORMS (20Hrs)

Fourier series, Fourier Integral formula, Fourier Transforms, Inversion theorem, Fourier Sine and cosine transforms, Inverse Fourier Sine and cosine Transforms, Linearity property of Fourier Transforms, change of scale property, Shifting property, Modulation theorem, Convolution definition, Convolution theorem for Fourier Transforms, Parseval's identity for transforms, Relationship between Fourier and Laplace Transforms. Finite Fourier Sine and cosine Transforms, Inversion Formula for Fourier Sine and cosine Transforms.

(Chapters:6[6.1 to 6.15, 6.17 to 6.20]; 7[7.1 to 7.4])

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Solve the problems using Laplace Transforms.
CO2: Demonstrate the use of Inverse Laplace Transform in Convolution theorem & Heaviside's expansion formula.
CO3: Evaluate the solutions of ordinary differential equations & Partial differential equations using Laplace transformations.
CO4: Synthesise the concepts of Fourier Transforms.

Prescribed Book:

A.R. Vasishta and Dr. R.K. Gupta, Laplace Transforms, Krishna Prakashan Media Pvt. Ltd. Meerut, 2016

Reference Books:

1. Baidyanath Patra, An introduction to Integral Transforms, 1st Edition, CRC Press, 2018.
2. Dr. S. Sreenadh, Fourier Series and Integral Transforms, S. Chand (G/L) & Company Ltd, 2014.
3. Dr. J.K. Goyal and K.P. Gupta, Laplace and Fourier Transforms, Pragati Prakashan, 2016.
4. M.D. Raisinghania, H.C. Saxsena and H.K. Dass, Integral Transforms, S. Chand (G/L) & Company Ltd, 2014.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: MACHINE LEARNING

COURSE CODE: HDS 522 **PPW: 4**
YEAR/SEMESTER: III/V **NO. OF CREDITS: 4**

COURSE OBJECTIVES:

COb1: To focus on Analytics for supervised and unsupervised statistical learning.
COb2: To understand the techniques of supervised machine learning concepts classification, k-Nearest Neighbor Classification, and Support Vector Machines Classifiers.
COb3: To develop the skills of applying machine learning techniques for solving Artificial Neural Network problems
COb4: To understand different methods of cluster analysis and identify the different groups with similar properties.

UNIT-I:

Introduction: Multivariate techniques – Concept and Applications, Supervised and Unsupervised Learning.
Data pre-processing: Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization, and Concept Hierarchy Generation.

Supervised learning-Classification, Issues Regarding Classification, Bayesian Classification Classification by Decision Tree Induction - Decision Trees- Regression Trees, Growing Trees, Regression Tree Issues, Pruning Trees, Combining Classifiers- Bootstrap Aggregation (Bagging), Boosting, Random Forest.

UNIT-II:

Classification techniques: K-nearest –Neighbour classifiers – Estimation and Rule, Metrics and Nearest Neighbor Classification, Support Vector Machines- linear SVM, Nonlinear SVM's, Kernel trick, Multi-class SVMs, Maximal Classifier, Metrics for Evaluating Classifier Performance, Holdout Method, and Random Subsampling.

UNIT-III:

Neural Networks: Overview, Artificial Neural Network(ANN) -Artificial Neurons, Components of ANN-Network Architecture (Feedforward & Feedback Network), Weights, Activation Function; Input Layer - Hidden Layers - Output Layer; Single Layer Perceptron Network, Multilayer Perceptron Network, Radial

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Basis Function Neural Network, Adaline and Medaline Networks, Back Propagation, Applications of Neural Network.

UNIT-IV:

Unsupervised Learning: Measures of distance - Different clustering methods (Distance, Density, Hierarchical, Grid) – Partitional clustering; Dealing with continuous, categorical values in K-Means, K-Medoids,k-Mode; Constructing a hierarchical Clustering-Agglomerative, Divisive; and density-based clustering.

COURSE OUTCOMES: At the end of the course, students will be able to

CO1: apply the skills in using recent machine learning software for solving real-life problems.
CO2: develop and use various quantitative and classification models based on various regression and decision tree methods
CO3: learn how to evaluate the soundness, appropriateness, and validity of the ANN model to forecast the future outcomes
CO4: explain the difference between different clustering methods.

Prescribed Book:

1. C. M. Bishop. Pattern Recognition and Machine Learning. 2nd Edition, Springer, 2015.
2. S. J. Russell, P. Norvig. Artificial Intelligence: A Modern Approach. Third Edition, Prentice-Hall, 2010.
3. Vincy Joseph, Anuradha Srinivasa Raghavan. Machine Learning, John Wiley & Sons, Wiley Edition, First Edition, 2019.

Reference Books:

1. P. Flach. Machine Learning: The Art and Science of Algorithms that Make Sense of Data. First Edition, Cambridge University Press, 2012.
2. B. Yegnanarayanan. Artificial Neural Networks, Publisher: Prentice-Hall of India Pvt.Ltd, 2003.
3. Y. S. Abu-Mostafa, M. Magdon-Ismail, H.-T. Lin. Learning from Data: A Short Course. First Edition, 2012.
4. Drew Conway, Joh Myles White. Machine Learning for Hackers. O'Reilly Media, Inc., Safari books online service, January 2012.
5. Oliver Theobald. Machine Learning For Absolute Beginners, Second Edition, Kindle, January 2018.
6. Chistopher M Bishop. Pattern Recognition and Machine Learning, Springer Edition, February 2010.
7. John D Kelleher, Brian Mac Namee, Aoife D'Arcy. Fundamentals of Machine Learning for Predictive Data Analytics- Algorithms, Worked Examples, and Case Studies, MIT Press, September 2015.
8. T. Hastie, R. Tibshirani and J. Friedman, Elements of Statistical Learning, Springer, 2009.
9. E. Alpaydin. Machine Learning, MIT Press, 2010.
10. K. Murphy. Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
11. Shai Shalev-Shwartz, Shai Ben-David. Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
12. John Mueller and Luca Massaron. Machine Learning For Dummies, John Wiley & Sons, 2016.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: MACHINE LEARNING PRACTICAL Using Python

PPW: 3
NO. OF CREDITS: 1

COURSE CODE: HDS522P
YEAR/SEMESTER: III/V

COURSE OBJECTIVE:

COb1: To familiarize the mathematical and statistical techniques used in machine learning.
COb2: To develop skills in using recent machine learning software for solving practical problems.

1. Computation of Decision Tree Analysis Using Python.
2. Computation of Naive Bayes Classification Analysis Using Python.
3. Computation of K -Nearest Neighbor Classifier Using Python.
4. Computation of Support Vector Machine Analysis Using Python.
5. Computation of Artificial Neural Network Analysis Using Python.
6. Computation of Cluster Analysis Using Python.

COURSE OUTCOMES: At the end of the practical course students will be able to

CO1: Select an appropriate pattern analysis tool for analyzing data.
CO2: Demonstrate proficiency in applying the scientific method to machine learning models.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: PREDICTIVE ANALYTICS

COURSE CODE: HDS523 **PPW: 4**
YEAR/SEMESTER: III/V **NO. OF CREDITS: 4**

COURSE OBJECTIVE:

COb1: Recommend appropriate types of predictive modeling for use in data analysis scenarios.
COb2: To understand the concept of various components of time series modeling.
COb3: To learn, how to develop AR(p), MA(q), ARMA (p, q) and ARIMA (p, q) models to forecast the future outcomes.
COb4: To understand and develop the skills in using Non-Linear Models ARCH and GARCH for solving practical problems

UNIT-I

Introduction: Predictive Analytics, Data Types- Structured, Semi-structured, Unstructured-Data visualization.

Linear Methods for Regression: Linear regression models and least squares, Multiple regression, Multiple outputs, Subset selection, Ridge regression, Lasso regression, Linear Discriminant Analysis, Logistic regression, Estimation of Regression Parameters, Model Diagnostics, and Model Selection.

UNIT-II

Time Series: Various Components of time series, Additive & Multiplicative models, Moving Average Method, Seasonal indices by Ratio to Moving Average, Ratio to Trend, and Link Relative Methods.

Stochastic Process and Model Building - Stochastic process, Stationarity, Data transformation, Autocorrelation, Autocorrelation Function (ACF), Partial Autocorrelation Function (PACF), Correlogram, Root Mean Squared Error (RMSE), Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD).

UNIT-III

Time Series forecasting Models: Principles of Forecasting, Linear Models for time series- Random Walk, White noise Process, Augmented Dickey-Fuller unit root test for stationary, Autoregressive Processes AR(p), Moving Average Processes MA(q), Autoregressive Moving Average Processes ARMA(p,q), and Autoregressive Integrated Moving Average Processes ARIMA(p,d,q) - Estimation of Parameters, Diagnostic Check- Ljung box test, Forecasting Accuracy.

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UNIT-IV

Non-linear Time Series Models: Introduction – Non-Linear Model- Autoregressive Conditional Heteroscedasticity (ARCH) models, Generalized Autoregressive Conditional Heteroskedasticity (GARCH)process, Parameter estimation, diagnostic checking, and forecasting. Evaluate ARCH (1) properties. GARCH (Concept only) process of modeling volatility.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: apply various regression techniques to predict the value of continuous variables.
CO2: Summarize and visualize datasets using appropriate predictive analytical tools.
CO3: learn how to apply and evaluate Box Jenkins Methodology to Forecast the future outcomes
CO4: Apply Non-linear predictive modeling approaches using a suitable package such as SPSS Modeler.

Prescribed Book:

1. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung. Time Series Analysis: Forecasting and Control, 5th Edition, John Wiley & Sons, 2016.
2. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulahci. Introduction to Time Series Analysis and Forecasting, Second Edition, John Wiley & Sons Publication, 2016.
3. James D. Hamilton, Time Series Analysis, Princeton University Press, 2014.

Reference books:

1. Ruey S. Tsay. Analysis of Financial Time Series, 3rd Edition, John Wiley & Sons, 2009.
2. A.C. Harvey. Time Series Models, 2nd Edition, Pearson Education Print, 2003.
3. Alexander, C, Market models: A guide to financial data analysis. John Wiley & Sons, 2001.
4. Bauwens, L., Hafner, C. M., & Laurent, S., Handbook of volatility models and their applications, John Wiley & Sons, 2012.
5. Francq C and Zakoian, J. M., GARCH models: structure, statistical inference and financial applications. John Wiley & Sons, 2011.
6. Satchell, S., & Knight, J, Forecasting volatility in the financial markets. Butterworth-Heinemann, 2011.
7. W A Fuller. Introduction to Statistical Series, 2nd Edition, John Wiley & Sons, 1995.
8. Chatfield C. Analysis of Time Series, An Introduction, CRC Press, 2003.
9. Giuseppe Ciaburro. Matlab for Machine Learning, Packt Publishing, 2017.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: PREDICTIVE ANALYTICS PRACTICAL Using SPSS

COURSE CODE: HDS523P **PPW: 3**
YEAR/SEMESTER: III/V **NO. OF CREDITS: 1**

COURSE OBJECTIVE:

COb1: Understand how to evaluate models generated from data.
COb2: Discover how to build predictive modeling, prepare data, and use different techniques using SPSS.

1. Computation of Multiple Regression Analysis.
2. Computation of Binary Regression Analysis.
3. Computation of Logistic Regression Analysis.
4. Computation of Method of Moving Average.
5. Computation of ACF and PACF plots.
6. Computation of Autoregressive Process (p).
7. Computation of Moving Average Process(q).
8. Computation of Autoregressive Moving Average Process (p,q).
9. Computation of ARIMA (p,d,q).
10. Computation of GARCH.

***Case Studies will be done based on above models**

COURSE OUTCOMES: At the end of the practical course students will be able to

CO1: Implement different predictive modeling algorithm techniques.
CO2: Identify and apply predictive modeling to solve real-world problems.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: SOFTWARE ENGINEERING (Elective)

COURSE CODE: HDS524A **PPW: 4**
YEAR/SEMESTER: III/V **NO. OF CREDITS: 4**

COURSE OBJECTIVE: To impart the knowledge of software concepts, importance of software development within time and budget.

UNIT-WISE COURSE OBJECTIVES:

COb1: To explain the basics of software, its process and types of process models.
COb2: To discuss Requirements Engineering, design concepts and Architectural styles of Software Engineering.
COb3: To describe about Software Quality and software testing strategies.
COb4: To identify Software Configuration Management process, software risks and reverse engineering.

UNIT-I:

Software Engineering: Software, Software Process.
Software Process Models- Waterfall Model, Incremental Model, Spiral Model, Personal Software Process, Team Software Process.
Agility: Agility, Agile Process, Extreme Programming.
Requirements Engineering: Inception, Elicitation, Elaboration, Negotiation, Specification, Validation.
(Ch: 1, 2, 3 and 5)

UNIT-II:

Developing Use Cases: UML Models That Supplement the Use Cases- Class Based Model, Data Flow Model (DFD), Relationships (ERD).
Design Concepts: The Design Process, Design Model -Architectural Design.
Architectural Styles: Data – Centered Architecture, Data Flow Architectures, Layered Architectures.
Architectural Design: Definition, Class-Based Design, Component-Level Design, User-Interface Design.
(Ch: 6, 7, 8, 9, 10 and 11)

UNIT-III:
Software Quality: Software Quality Factors-Mccall's Quality Factors, ISO 9126 Quality Factors, Achieving Software Quality.
Software Quality Assurance: Elements of Software Quality Assurance, ISO 9000 Quality Standards.

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Software Testing Strategies: Strategic Approach to Software Testing, Verification and Validation, Integration Testing, Regression Testing, Debugging Process, Black Box Testing, White Box Testing. (Ch: 14, 16, 17 and 18)

UNIT-IV:

Software Risks: Risk Mitigation, Monitoring and Management, Software Re-engineering, Reverse Engineering and Forward Engineering.

Software Configuration Management: Definition, SCM Process, Version Control, Change Control, Configuration Audit, Status Reporting.

(Ch: 22, 28 and 29)

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Summarize the basics of software, its process and types of process models.
CO2: Interpret about Requirements Engineering, design concepts and Architectural styles of Software Engineering.
CO3: Analyze about Software Quality and software testing strategies.
CO4: Explain Software Configuration Management process, software risks and Reverse engineering.

Prescribed Book:

1. Roger S Pressman, B R Maxim, Software Engineering–A Practitioner's Approach (7e), MC Graw Hill 2010.

Reference Books:

1. Ian Sommerville, Software Engineering, 9th Edition, 2004.
2. Hans Van Vliet, Software Engineering Practices, 3rd Edition, 2008.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: SOFTWARE ENGINEERING LAB

COURSE CODE: HDS524AP **PPW: 2**
YEAR/SEMESTER: III/V **NO. OF CREDITS: 1**

COURSE OBJECTIVE: To Impart the knowledge of different Data Models, E-R Diagrams and case tools in designing the software.

COb1: To inculcate knowledge in defining problem statement and its specifications.

COb2: To demonstrate various UML models using below Case studies.

Case Studies:

1. Banking System.
2. Hotel management system.
3. Inventory Control System.
4. Library management system.
5. Railway Reservation System.

Choose any two of above case studies and do the following exercises for that case studies:

1. Write the complete problem statement.
2. Write the software requirements specification document.
3. Draw the entity relationship diagram.
4. Draw the data flow diagrams.
5. Draw use case diagrams.
6. Draw activity diagrams for all use cases.
7. Draw sequence diagrams for all use cases.
8. Draw collaboration diagram.
9. Assign objects in sequence diagrams to classes and make class diagram.

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Note:

To draw dataflow diagrams using Microsoft Visio Software, SmartDraw, etc.

To draw UML diagrams using Rational Rose Software, StarUML, etc.

COURSE OUTCOMES: At the end of the practical course students will be able to

CO1: Write problem statement.

CO2: Use tools to draw various UML models.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: SYSTEM AND NETWORK ADMINISTRATION
(ELECTIVE-IIB)

COURSE CODE: HDS524B **PPW: 4**
YEAR/SEMESTER: III/V **NO. OF CREDITS: 4**

COURSE OBJECTIVE: To educate the students in System and Network Administration utilities.

UNIT-WISE COURSE OBJECTIVES:

COb1: To learn UNIX Essential Administrative Tools and Techniques.
COb2: To acquire knowledge about User and Groups Account Management and Managing System Resources.
COb3: To provide the concepts related to Maintenance of File System, Secondary Storage Devices and Backup Techniques.
COb4: To explain the functionalities of TCP/IP and E-Mail.

UNIT-I:

Introduction to System Administration: Thinking about System Administration, Becoming Superuser, Communicating with Users.

The UNIX Way: Files – File Ownership – File Protection – Mapping Files to Disk, Process - Interactive Processes – Batch Processes – Daemons – Process Attributes, Devices, The Root Directory.

Essential Administrative Tools and Techniques: Getting the most from Common Commands - Piping into grep and awk - Finding Files - Repeating Commands, Essential Administrative Techniques – Periodic Program Execution: The cron Facility – System Messages, Administrative Log Files.

(Ch: 1, 2 and 3)

UNIT-II:

Managing Users and Groups: UNIX Users and Groups – The Password File – The Shadow Password File - The Group File – Dynamic Group Memberships – User Account Database File Protections, Managing User Accounts – Adding a New User Account – Defining a New User Account – Assigning a Shell, Creating a Home Directory – User Environment Initialization Files – Setting File Ownership – Disabling and Removing User Accounts, Administering User Passwords – Selecting Effective Passwords.

Managing System Resources: Thinking about System Performance, Monitoring and Controlling Processes – The ps command – The /proc File System – Kernel Idle Processes – Process Resource Limits, Managing CPU Recourses – Nice Numbers and Process Priorities – Monitoring CPU Usage, Managing

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Memory, Disk I/O Performance Issues – Monitoring Disk I/O Performance – Getting the Most from the Disk Subsystem.

(Ch: 6 and 15)

UNIT-III:

File Systems and Disks: File System Types, Managing File Systems – Mounting and Dismounting File Systems – Disk Special File Naming Conventions – The Mount and Unmount Commands – Figuring out who's using a File – The File System Configuring File – Automatic File System Mounting – Using fsck to validate a File System, From Disks to File systems – Defining Disk Partitions – Adding Disks- Logical Volume Managers.

Backup and Restore: Planning for Disasters and Everyday Needs – Backup Capacity Planning – Backup Strategies – Backup Media – Comparing Backup Media, Backing Up Files and File system, Backing Up Individual File systems with Dump, Restoring Files from Backups – Restores from tar and cpio Archives – Restoring from Dump Archives – Moving Data Between Systems.

(Ch: 10 and 11)

UNIT-IV:

TCP / IP Networking: Administrative Commands, Adding a New Network Host – Configuring the Network Interface with ifconfig.

Managing Network Services: Managing DNS Servers – Name Server Types, about BIND – Configuring Named.

Electronic Mail: About Electronic Mail – Mail Addressing and Delivery- Electronic Mail Policies, Configuring User Mail Programs.

(Ch– 5, 8 and 9)

COURSE OUTCOMES: At the end of the course, students will be able to

CO1: Understand the UNIX Essential Administrative Tools and Techniques.
CO2: Manage the User and Groups Account Management and Managing System Resources.
CO3: Acquire knowledge on Maintenance of File systems, Secondary Storage Devices and Backup Techniques.
CO4: Be familiar with the functionalities of TCP/IP and E-Mail.

Prescribed Book:

Aeleon Frisch, Essential System Administration, O'Reilly, Third Edition, 2002.

Reference Books:

1. Nemeth, UNIX System Administration, Pearson Education, 2000.
2. Thomas A. Limocelli, The Practice of System and Network Administration, Pearson Education, 2007, Second Edition.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: SYSTEM ADMINISTRATION USING UNIX LAB

COURSE CODE: HDS524BP **PPW: 2**
YEAR/SEMESTER: III/V **NO. OF CREDITS: 1**

COURSE OBJECTIVE: To impart knowledge about UNIX system administration commands.

COb1: To implement the system administrative commands, system calls in Unix.
COb2: To program the implementation of system calls in Unix.

1. Creating users and groups (Execution of various system administration Commands such as useradd, usermod, password, groupmod, uname, permission(r,w,x)(4,2,1), umask, chmod and chown.
2. Write a shell script that takes a command line argument and reports on whether it is directory, a file or something else.
3. Program to search for a given pattern in a file.
4. Write a shells script that accepts one or more file names as arguments and converts all of them into Uppercase, provided they exist in the current directory.
5. Write a shells script to delete all the temporary files.
6. Write a program to create a child process using fork() and exec() system calls.
7. Write a program using open(), read() and write() system calls.
8. Implementation of Signals in UNIX.
9. Write a shells script to check and list attributes of a processes.
10. Write a shells script to display list of users currently logged in.
11. Write a C program to illustrate the Race Condition.
12. Write a C Program which demonstrates inter process communication between a reader process and a writer process.
13. Write a C program for Inter process communication using pipes.

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COURSE OUTCOMES: At the end of the practical course students will be able to

CO1: Implement the System administrative commands in Unix.
CO2: Program the system calls in Unix.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: BIOINFORMATICS (GE)

COURSE CODE: HDS525 **PPW: 4**
YEAR/SEMESTER: III/V **NO. OF CREDITS: 4**

COURSE OBJECTIVE: The objective of this course is to explain the application of data science and bioinformatic tools in analyzing biomolecules.

UNIT-WISE COURSE OBJECTIVES:

COb1: To explain the structure of nucleic acids and proteins.
COb2: To discuss the various databases available for biomolecules
COb3: To discuss the analysis of DNA/RNA using biopython
COb4: To demonstrate the analysis of proteins using bio python

UNIT- I: Introduction to nucleic acids and biopython package **15 hrs**

Structural organization of Cell
Structure and composition of DNA (Deoxyribonucleic acid) and RNA (Ribonucleic acid)
Basic definition of genes, genome sequences
Gene annotation: Open reading frames (ORFs), introns, exons, splice variants, promoter regions
CpG islands, isochores, satellite regions in DNA sequence
Biopython- Introduction of Biopython package and its applications
Identification and prediction of CpG islands, ORFs and promoter regions using biopython.

UNIT- II: Biological Databases **15hrs**

Overview of biological databases-private and public data sources.
Literature databases
Nucleotide databases- NCBI, DDBJ
Sequence information resources: EMBL GENBANK Entrez Unigene
Protein databases-Primary and secondary database
Protein Structure databases (FSSP, CATH, SCOP) and Protein Information resources (Protein Data Bank (PDB), MMDB, Swiss-Prot, TrEMBL)
Specialized Genome databases (SGD, TIGR)

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UNIT- III: Nucleotide sequence analysis **15 hrs**

Introduction to Basic Local Alignment Search Tool (BLAST) algorithm
Types of BLAST
Nucleotide sequence alignment using BLAST (Basic and Local alignment)
Alignment of sequences using biopython
Phylogenetic tree construction
Outline of Transcription
Structure of RNA
Prediction of RNA structure using biopython

UNIT- IV: Protein – structure and analysis **15 hrs**

Outline of translation
Structural organization of Proteins
Retrieving protein sequences from protein databases
Multiple sequence alignments of proteins
Phylogenetic tree construction
Physico chemical properties (molecular weight, isoelectric point etc) of proteins and their computation using biopython
Prediction of secondary structure of protein using biopython

COURSE OUTCOMES: At the end of the course students will be able to

CO1: To distinguish the structure and function of nucleic acids and proteins
CO2:. To retrieve the sequences of biomolecules from relevant databases
CO3: To implement the use of bioinformatics tools to analyse nucleotide sequences using biopython
CO4: To evaluate the structure and sequences of proteins using biopython tools

Reference Books:

1. Dan E. Krane, Michael L. Raymer, Fundamental Concepts of Bioinformatics.
2. Jonathan Pevsner, Bioinformatics and Functional Genomics.
3. Andreas D. Baxevanis and B. F. Francis Ouellette, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins.
4. Peter Clote and Rolf Backofen, Computational Molecular Biology: An Introduction, 2000. Wiley.

RESOURCES

1. URL : http://www.biopython.org

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: ARTIFICIAL INTELLIGENCE

COURSE CODE: HDS621 **PPW: 4**

YEAR/SEMESTER: III/VI **NO. OF CREDITS: 4**

COURSE OBJECTIVE: To enable students relate to the concepts of game playing and problem solving through various methods in Artificial Intelligence.

UNIT-WISE COURSE OBJECTIVES:

COb1: To identify Problem, Problem Space and Problem Search.
COb2: To implement various Search techniques that help in different types of problem solving.
COb3: To explain on the intelligent agents, their performance measures and Learning Concepts.
COb4: To interpret Game playing as a Problem search and applications of Artificial Intelligence in real-world.

UNIT-I:

Introduction to Artificial Intelligence- Introduction, AI Techniques, Problem Solving with AI, AI Models, Data acquisition and Learning Aspects in AI, **Problem Solving-** Problem Solving Process, Formulating Problems, Problem Types and Characteristics, Performance Measuring, Problem Space and Search, Problem Reduction Methods, Real-World Problems.
(Ch: 1 and 2)

UNIT-II:

Uninformed Search: General Search Algorithm, Uninformed Search Methods: Breadth-First Search (BFS), Uniform Cost Search, Depth-First Search.

Informed Search: Generate and Test, Best First Search, A* search, Local Search Algorithms and Optimisation Problems- Hill Climbing Search, Adversarial Search Methods- Minimax Algorithm.
(Ch: 3 and 4)

UNIT-III:

Intelligent Agent: What is an intelligent agent? Rationality and Rational Agent, Performance Measures, Rationality and Performance, Flexibility and Intelligent Agents, Task Environment and its Properties.
Learning: What is Machine Learning? Learning Paradigms, Learning Concepts, Methods and Models.
(Ch: 5 and 10)

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UNIT-IV:

Game Playing: Important Concepts of Game Playing, Game Playing and Knowledge Structure, Game as a Search Problem.
Applications of Artificial Intelligence: Range of Applications, AI: Applications and Examples.
(Ch: 15 and 19)

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Outline problem, problem space based on problem characteristics.
CO2: Choose the appropriate search technique for various problems.
CO3: Summarize about various intelligent agents and the learning concepts.
CO4: Articulate game playing as a problem search and the real-world applications of Artificial Intelligence.

Prescribed Book:

1. Parag Kulkarni, Prachi Joshi, Artificial Intelligence- Building Intelligent Systems, First Edition, 2021.

Reference Books:

1. Elaine Rich, Artificial Intelligence, Tata-McGraw Hill, Third Edition, 2012.
2. Stuart Russell and Peter Norvig, Artificial Intelligence: A modern Approach, Third Edition, 2018.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: CLOUD COMPUTING (ELECTIVE – IA)

COURSE CODE: HDS622A **PPW: 4**
YEAR/SEMESTER: III/VI **NO. OF CREDITS: 4**

COURSE OBJECTIVE: To impart knowledge in students with the concepts of Cloud Computing and Virtualization.

UNIT-WISE COURSE OBJECTIVES:

COb1: To explain the concepts of cloud computing, cloud computing reference model, characteristics and its benefits.
COb2: To discuss the concepts of parallel computing, distributed computing and components of a distributed system.
COb3: To identify the characteristics of virtualization, pros and cons of virtualization.
COb4: To describe the cloud reference model, cloud computing architecture, and types of clouds.

UNIT-I:

Fundamentals: Introduction, Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, The Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments, Distributed Systems, Virtualization, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms And Technologies (Amazon Web Services(AWS),Google App Engine, Microsoft Azure).

(Ch: 1)

UNIT-II:

Principles of Parallel and Distributed Computing: Eras of Computing, Parallel Vs. Distributed Computing, Elements of Parallel Computing, What is Parallel Processing? , Hardware Architectures for Parallel Processing, Approaches to Parallel Programming, Levels of Parallelism, Laws of Caution, Elements of Distributed Computing, General Concepts and Definitions, Components of a Distributed System, Architectural Styles for Distributed Computing, Models for Inter-process Communication, Technologies for Distributed Computing, Remote Procedure Call, Distributed Object Frameworks, Service-Oriented Computing.

(Ch: 2)

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UNIT - III:

Virtualization: Introduction, Characteristics of Virtualized Environments, Increased Security, Managed Execution, Portability, Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Advantages of Virtualization, The Other Side of the coin: Disadvantages, Technology Examples, Xen: Paravirtualization, VMware: Full Virtualization, Microsoft Hyper-V.

(Ch: 3)

UNIT-IV:

Cloud Computing Architecture: Introduction, Cloud Reference Model, Architecture, Infrastructure/Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open challenges, Cloud definition, Cloud Interoperability and Standards, Scalability and Fault Tolerance, Security, Trust, and Privacy, Organizational Aspects.

(Ch: 4)

COURSE OUTCOMES: At the end of the course, students will be able to

CO1: Explain cloud computing, cloud computing reference model and characteristics.
CO2: Paraphrase parallel computing, distributed computing and components of a distributed system.
CO3: Apprehend characteristics of Virtualization, technology examples of virtualization.
CO4: Identify cloud reference model, cloud computing architecture, and types of clouds.

Prescribed Book:

1. Raj kumar Buyya, ChristianVecchiola, S.Thamarai Selvi, Mastering Cloud Computing, McGraw Hill Education (India) Private Limited, 2013.

Reference Books:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski , Cloud Computing: Principles and Paradigms , Wiley Publisher, 2011.
2. Thomas Erl,Zaigham Mahmood and Ricardo Puttini , Cloud Computing: Concepts, Technology & Architecture, Pearson Education India; 1st edition, 2014.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: BLOCKCHAIN TECHNOLOGY (ELECTIVE – IB)

COURSE CODE: HDS622B
YEAR/SEMESTER: III/VI

PPW: 4
NO. OF CREDITS: 4

COURSE OBJECTIVE: To impart knowledge in students to develop web-based applications.

UNIT-WISE COURSE OBJECTIVES:

COb1: To describe the concepts of Blockchain and Decentralized Systems.

COb2: To demonstrate Hash Functions and Consensus Methods.

COb3: To discuss Blockchain Components and its Allied Technologies.

COb4: To illustrate the concepts of Smart Contracts and Blockchain Usecases.

UNIT-I:

Basics of Blockchain: Introduction, Concept of Blockchain, History, Definition of Blockchain, Fundamentals of Blockchain, Characteristics of Blockchain, Consensus in Trust-Building Exercise; Public, Private, and Hybrid Blockchains, Distributed Ledger Technologies, DLT Decentralized Applications and Databases, Architecture of Blockchain, Transactions, Chaining Blocks, Value Proposition of Blockchain Technology.

Decentralized System: Introduction, Distributed Decentralized Databases, Decentralized Enterprise, Decentralization, Disintermediation, Decentralized Enterprise Regulation.

(Ch: 1 and 2)

UNIT-II:

Hash Functions: Introduction, Hashing, Message Authentication Code, Secure Hash Algorithm (SHA-1), Secure Hash Algorithm Version, Distributed Hash Tables, Hashing and Data Structures, Hashing in Blockchain Mining.

Consensus: Introduction, Consensus Approach, Consensus Algorithms, Byzantine Agreement Methods.

(Ch: 3 and 4)

UNIT-III:

Blockchain Components: Introduction, Ethereum, History, Ethereum Virtual Machine, Working of Ethereum, Ethereum Clients, Ethereum Key Pairs, Ethereum Addresses, Ethereum Wallets, Ethereum Transactions, Ethereum Languages, Ethereum Development Tools.

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Blockchain and Allied Technologies: Blockchain and Cloud Computing, Characteristics of Blockchain Cloud, Blockchain and Artificial Intelligence, Blockchain and IoT, Blockchain and Machine Learning, Blockchain and Robotic Process Automation.

(Ch: 5 and 11)

UNIT-IV:

Smart Contracts: Introduction, Smart Contracts, Absolute and Immutable, Contractual Confidentiality, Law Implementation and Settlement, Chracteristics, Internet of Things, Utilities: Smart Grid, Proof of Origin, Supply Chain Management, Medical Sciences, Finance, Media and Entertainment, Public Services, Legal Services, Darknet, The Future.

Blockchain Vertical Solutions and Use Cases: Blockchain, Blockchain in Insurance, Assets Management, Smart Assets, Electronic Currency, Maufacturing.

(Ch: 7 and 10)

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Explain the concepts of Blockchain and Decentralized Systems.
CO2: Implement Hash Functions and Consensum Methods.
CO3: Summarize Blockchain Components and its Allied Technologies.
CO4: Paraphrase the concepts of Smart Contracts and Blockchain Usecases.

Prescribed Book:

1. Kumar Saurabh, Ashutosh Saxena, Blockchain Technology Concpets and Applications, Wiley Publications, First Edition, 2020.

Reference Books:

1. Daniel Hellwig, Goran Karlic, Arnd Huchzermeier, Build Your Own Blockchain – A Practical guide to Distributed Ledger Technolog, Springer,2020.
2. Arshdeep Bahga, Vijay Madisetti, Blockchain Applications – A Hands-on Approach, VPT Publications, 2018.
3. Debajani Mohanty, Blockchain from Concept to Execution, BPB Publications, 2018.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: NETWORK SECURITY (ELECTIVE-IIA)

COURSE CODE: HDS623A
YEAR/SEMESTER: III/VI

PPW: 4
NO. OF CREDITS: 4

COURSE OBJECTIVE: To enhance the student's knowledge on security issues those are seen in the present society and understand the ways to overcome them.

UNIT-WISE COURSE OBJECTIVES:
COb1: To discuss the overview of security attacks, encryption techniques.
COb2: To describe public key cryptology and principles.
COb3: To illustrate authentication systems and hash functions.
COb4: To apply about different cryptographic algorithms.

UNIT-I:
Security attacks, Security Services, Model for network security, conventional encryption model, Classical encryption techniques, DES, Triple DES, international data encryption algorithm.
(Ch: 1, 2, 3 and 6)

UNIT-II:
Public – key cryptology, principles of public – key cryptosystems, RSA algorithm, key management, distribution of public keys, public key – distribution of secret keys.
(Ch: 9 and 14)

UNIT - III:
Authentication and digital systems, authenticate requirements – functions, cryptographic checksum, hash function, digital signatures, authentication protocols, Kerberos, X-509 directory, authentication services.
(Ch: 12, 13 and 15)

UNIT-IV:
Diffie – Hellmann key exchange, digital signature standards.
Cryptographic algorithms, The MD 5 message digest algorithm, Secure Hash algorithm, Electronic mail and management security – pretty good privacy (PGP).
(Ch: 12, 13 and 15)

COURSE OUTCOMES: At the end of the course students will be able to

CO1: Paraphrase security attacks, encryption techniques.
CO2: Explain public key cryptology and principles.
CO3: Apply authentication systems and hash functions.
CO4: Illustrate different cryptographic algorithms.

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Prescribed Book:

1. William Stallings, Cryptography and Network Security – Principles and Practice, Sixth Edition, Kindle Edition, 2017.

Reference Books:

1. Behrouz A Forouzan, Debdeep Mukhopadhyay, Cryptography and Network Security, McGraw-Hill Education, SIE, Third Edition, 2015.
2. Atul Kahate, Cryptography and Network Security, Mc Graw Hill, 2nd Edition, 2009.
3. Bernard Menezes, Network Security and Cryptography, CENGAGE Learning, First Edition, 2010.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: INTERNET OF THINGS (ELECTIVE –IIB)

COURSE CODE: HDS623B **PPW: 4**
YEAR/SEMESTER: III/VI **NO. OF CREDITS: 4**

COURSE OBJECTIVE: To enhance the student's knowledge to understand the advancements in sensor networks, mobile devices, wireless communications, networking and cloud technologies.

UNIT-WISE COURSE OBJECTIVES:

COb1: To explain the overview of internet of things, IoT enabling technologies, domain-specific IoTs, know the similarities and differences between IoT and M2M.

COb2: To describe the generic design methodology for Internet of Things and the basics of python.

COb3: To demonstrate a new device called as Raspberry Pi device and usage of cloud platforms and frameworks and services.

COb4: To summarize different case studies and various approaches to collect and analyze the data generated.

UNIT-I:

Introduction to Internet of Things (IoT): physical, logical design of IoT, IoT enabled technologies, IoT levels & development templates.
Domain specific IoTs, IoT and M2M: Introduction, M2M, Difference between IoT and M2M.
(Ch:1, 2 and 3)

UNIT-II:

IoT platforms Design Methodology: Introduction, IoT design Methodology, Case Study on IoT system for weather monitoring.
IoT Systems: logical design with Python: Python data types & data structures, control flow, functions, modules, packages, date/time operations, Python packages for interest of IoT.
(Ch: 5 and 6)

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UNIT - III:

IoT Physical Devices and Endpoints: What is IoT Device, Exemplary Device- Raspberry Pi, about the board, Programming Raspberry Pi with Python, about other IoT devices.
IoT physical servers and cloud offerings: Introduction, WAMP, Python Web Application Framework – Django, Amazon Web Services for IoT.
(Ch:7 and 8)

UNIT-IV:

Case Study illustrating IoT Design: Introduction, Home Automation, Home Intrusion Detection, Cities, Weather Monitoring System, Agriculture.
Data Analytics for IoT: Introduction, MapReduce programming model, MapReduce job execution workflow, Hadoop cluster setup, Introduction to Apache Oozie, Define Apache Spark, Apache Storm environment introduction
Tools For IoT: Introduction, chef components.
(Ch: 9, 10 and 11)

COURSE OUTCOMES: At the end of the course, students will be able to

CO1: Paraphrase the internet of things, IoT enabling technologies.
CO2: Summarize the generic design methodology for the Internet of Things and the basics of python.
CO3: Identify Raspberry Pi device, cloud platforms, frameworks, and services.
CO4: Categorize various case studies and approaches to collect and analyze the data generated.

Prescribed Book:

1. Arshdeep Bahga, Vijay Madisetti, Internets of Things – a Hands-on Approach, Second edition, 2016.

Reference Books:

1. Don Deloache, Emil Berthelsen and Wael Elrifai, The future of IoT: leveraging the shift to a data-centric world, self published., 2017.
2. Adrian McEwen(author), hakim cassimally, Designing the Internet of Things, 1st edition, ISBN- 13:978-1118430620., 2014.
3. Raj Kumar buyya (editor), Amir vahiddastjerdi (editor), Internet of things: principles and paradigms 1st edition, ISBN-13: 978-0128053959, 2016.

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PROGRAM NAME: B Sc (Honours) Data Science
(w.e.f. 2022-2023)
COURSE NAME: ECONOMIC THEORY AND FINANCIAL MARKETS

COURSE CODE: HDS624 **PPW: 4**
YEAR/SEMESTER: III/VI **NO. OF CREDITS: 4**

COURSE OBJECTIVE: This course is designed to introduce the basic concepts and principles of microeconomics and macroeconomics theory and acquaint the students with the elementary understanding of the financial markets.

UNIT-WISE COURSE OBJECTIVES:

COb1: To familiarize with the concept of microeconomics principles, equilibrium and the role of prices in allocating scarce resources for optimum use.
COb2: To learn the different approaches for the calculation of national Income and understand the concept of circular flow of Income and inflation.
COb3: To enable the students to acquaint the elementary understanding of the financial markets.
COb4: To equip with the basic understanding of the portfolio selection and the trade-off between risk and return.

UNIT I: Introduction to Microeconomics

Resource allocation – economic laws – market and market mechanism – demand and supply –determinants of demand/supply; demand/supply schedule and demand/supply curve - shifts in the demand/supply curve, demand, and supply together - concept of equilibrium - how prices allocate resources; Concept of elasticity.

UNIT II: Introduction to Macroeconomics

Basic concepts in macroeconomics – stocks and flows – static and dynamic equilibrium – national income concepts – circular flow of income – measurement of national income - Real versus Nominal GDP – GDP Deflator, Inflation and its types.

UNIT III: Financial Markets

Basics of financial markets and financial environment – major players in financial markets – instruments of financial markets – financial intermediation – investment banking and brokerage services – securities – types of securities – market for securities – how and where traded – initial public offering (IPO) – secondary markets.

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NIT IV: Introduction to Security Analysis

ortfolio theory and portfolio selection – Investment – gambling and speculation -Risk and Return – oncepts-Relationship Between Risk and Return- trade-off between risk and return-Risk Diversification- ystemic and Systemic risk; Measuring the Risk-Variance and Standard Deviation.

OURSE OUTCOMES: At the end of the course students will be able to

O1: Examine the role of market mechanism in the allocation of scarce resources for optimum use.
O2: Demonstrate the knowledge to understand the concepts for the calculation of national income.
O3: Describe the functioning of the financial markets.
O4: Evaluate the risk and return of an investment for portfolio selection.

rescribed Book:

Ahuja, A.L: Principles of Economics. S. Chand and company Ltd.
Chopra, P. N: Microeconomics. Kalyani Publications.
Ahuja, H.L: Macro Economic Theory policy, S. Chand Publishing.
Jhingan, M. L: Macro Economic Theory, Vrinda Publications.
Investment Analysis and Portfolio Management: Prasanna Chandra, TMH, third edition.
Security Analysis and Portfolio Management: Punithavathy Pandian, Vikas publishing House.

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