Mahatma Gandhi University

Faculty of Science

B.Sc.- Honors (Computer Science)

CBCS Pattern With effect from the Academic Year 2023-24

Semester-I

Code	Course Title	Course Type	HPW	Credits
BSH101	Communication (B.Sc. Syllabus)	AECC-1	2	2
BSH102	English (B.Sc. Syllabus)	CC-1A	4	4
BSH103	Second Language(B.Sc. Syllabus)	CC-2A	4	4
BSH104	**Fundamentals of Information Technology**	DSC-1	2T+2P	2+1=3
BSH105	**Programming with C**	DSC-2	3T+2P	3+1=4
BSH106	Calculus and Differential Equations	DSC-3	4T	4
BSH107	Statistics and Probability Models	DSC-4	3T+2P	3+1=4
			27	25

Semester-II

Code	Course Title	Course Type	HPW	Credits
BSH201	Environmental Studies(B.Sc.)	AECC-2	2	2
BSH202	English(B.Sc. Syllabus)	CC-1B	4T	4
BSH203	Second Language(B.Sc. Syllabus)	CC-2B	4T	4
BSH204	**Computer Organization**	DSC-5	4T	4
BSH205	**Problem Solving and Python Programming**	DSC-6	3T+2P	3+1=4
BSH206	Algebra	DSC-7	4T	4
BSH207	Statistical Inference	DSC-8	3T+2P	3+1=4
			28	26

Semester III

Code	Course Title	Course Type	HPW	Credits
BSH301	**Linux Tools and Utilities**	SEC-1	2	2
BSH302	English (B.Sc. Syllabus)	CC-1C	4	4
BSH303	Second Language(B.Sc. Syllabus)	CC-2C	4	4
BSH304	**Data Structures and Algorithms**	DSC-9	4T	4
BSH305	**Object Oriented Programing Using Java**	DSC-10	3T+2P	3+1=4
BSH306	Discrete Mathematics	DSC-11	4T	4
BSH307	Statistical Methods	DSC-12	3T+2P	3+1=4
			29	26

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Semester IV

Code	Course Title	Course Type	HPW	Credits
BSH401	**Mini Project**	SEC-2	4P	2
BSH402	English(B.Sc. Syllabus)	CC-1D	4	4
BSH403	Second Language(B.Sc. Syllabus)	CC-2D	4	4
BSH404	**Operating Systems**	DSC-13	3	3
BSH405	Database Management Systems	DSC-14	3T+2P	3+1=4
BSH406	Real Analysis	DSC-15	4T	4
BSH407	Optimization Techniques with R	DSC-16	3T+2P	3+1=4
			29	25

Semester-V

Code	Course Title	Course Type	HPW	Credits
BSH501	Number Theory	SEC-3	2	2
BSH502	Fundamentals of Cyber Security	GE-1	4	4
BSH503	**Artificial Intelligence**	DSC-17	3T+1T	4
BSH504	**Web Programming**	DSC-18	3T+2P	4
BSH505	Linear Algebra	DSC-19	4T	4
BSH506	Data Modelling through Machine Learning Techniques	DSC-20	3T+2P	3+1=4
BSH507	Elective-1 1. **Information Retrieval systems** 2. **Image Processing**	DSE-1	4T	4
			29	26

Semester VI

Code	Course Title	Course Type	HPW	Credits
BSH601	SciLab	SEC-4	1T+2P	1+1=2
BSH602	Design and Analysis of Algorithms	DSC-21	3T+1TU	4
BSH603	Data Mining using Python	DSC-22	3T+2P	3+1=4
BSH604	Software Engineering	DSC-23	3T+2P	3+1=4
BSH605	Deep Learning	DSC-24	3T+2P	3+1=4
BSH606	Elective-II 1. **Big Data** 2. **Natural Language Processing**	DSE-2	3T+2P	3+1=4
BSH607	**Project**	**Project**	3	3
			29	25

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Semester-VII

Code	Course Title	Course Type	HPW	Credits
BSH701	**Research Methodology**	DSCH1	3	3
BSH702	**Cloud Computing**	DSCH2	3	3
BSH703	**Computer Networks**	DSCH3	3	3
BSH704	**Elective-III** **1. Cryptography** **2. Enterprise Systems**	DSEH-1	3	3
BSH705	**Selenium: Automated Testing for Web Applications**	Skill Lab	2P	1
BSH706	**Project Work / Industry Internship Phase-1**	Project	2	2
			26	15

Semester-VIII

Code	Course Title	Course Type	HPW	Credits
BSH801	**Project Work / Industry Internship Phase-II**	Project	12	12
			12	12

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B.Sc.-Honors (Computer Science)

Semester -I

DSC–1

Fundamentals of Information Technology

Theory	2 Hours/Week	2credits
Practical	2 Hours/Week	1credit

Unit -I

Digital Age: Digital basis of Computers, Data/Information, Hardware Input, Output, Memory, Communication Hardware, Software, Application Software, System Software, Communications, Five kinds of Computers, Development in communication Technology, Connectivity and . Interactivity, Five Generations of Programming Languages, Programming languages used today, Object Oriented & Visual Programming.

Operating Systems: Booting, Managing Storage, Resources, Files tasks, Common operating systems

Unit -II

Processors: The CPU and Main Memory, Data Representation, Micro Computer System Unit, Input & Output devices, Keyboard, Pointing devices, Diskettes, Hard-disks, Optical disks, Flash memory, Magnetic tape, Compression and Decompression.

Files & Databases: Data storage hierarchy, File management, Files Management Systems, Database Management Systems,

Unit -III

Telecommunications: DATA, Video, Audio communication, the Internet, the World Wide Web, new Internet technologies, Communication channels, Networks, conduits of communication, Communication networks, Local networks, factors affecting communication among devices.

Application Software: Common features of software, Word processing, Spread sheet, software for Cyber space, Internet programming, HTML, XML, & Active X.

Unit- IV

Information Systems: Organization:- Departments, Tasks, Management Information systems, Six phases of system analysis and design. Software Development: Programming as a five step procedures.

Security Issues: Threats to computers & Communication systems, Safeguarding computers, and communications.

Suggested Reading:

1. Williams B.K. Sawyer et.al., *"Using. information Technology"*, Sixth Edition, Tata McGraw Hill, 2006.

References:

1. Aksoy & DeNardis " *Introduction to fr?tormatiol1 technology"*, Cengage Learning, 2006.
2. Dennis P. Curtin & Kim Folley, et.a!., *n!l?!i>rll1utiol1 Technolop,y. The breaking Wave"*, Tata McGraw Hill, 1998.
3. ITL Edn Solutions Ltd. *"Introduction to b!formaiiol1 Technology"*, Pearson Education,2005.

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Fundamentals of Information Technology LAB

Practical 2 Hours/Week 1credit

At the end or the course, students should be able to:

1. Identify and describe the relationships and role of the components of the "Logical' diagram of the computer. (e.g. processor, RAM, ROM, BIOS, input, output, storage.)

2. Relate the "logical" diagram of a computer system to the "physical" system by identifying physical components of a computer and describing their purpose. (e.g. the processor, memory chips, motherboard, disk drives, and controller cards such as AGP board, network cards, sound card, as well as parallel and serial ports etc)"

3. Assemble the computer which they will use and load the OS with partitions for Windows and Linux, configure for network connection.

4. Troubleshoot his/her PC from time to time.

5. Install/Un installs SW/HW on his/her PC from time to time.

6. Identify and distinguish between various types of application software. by describing and using them. (e.g. word processor, spreadsheet, database, browser, mailers etc.)

7. MS Word: Create documents with standard formatting commands, single/multi column, insert pictures/objects, drawings, hyperlinks, header/footer, and tables. No macros.

8. MS Power Point: Create presentations with preset animations, using different layouts, backgrounds, slide master, insert pictures/objects, drawings, hyperlinks, header/footer, tables

9. MS Excel: Creating worksheets with various kinds of data, making charts, conditional formatting, awareness of the various functions- statistical, date/time, math/trig etc, ability to explore (help) and use these functions if need be, demonstration through some common functions like sum, average, standard deviation, logical and information.

10. HTML: Should be able to create their web-page (title, text, frames, hyperlinks to some sites, pictures, lists, tables, fonts, forms and color) without using any web authoring tools.

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DSC–2

Programming With C

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit – I

Basics of C: Overview of C, Developing Programs in C, Parts of Simple C Program, Structure of a C Program, compilation and linking processes, Comments, Program Statements, C Tokens, Keywords, Identifiers, Data Types, Variables, Constants, Operators and Expressions, Expression Evaluation–precedence and associativity, Type Conversions.

Input-Output: Non-formatted and Formatted Input and Output Functions, Escape Sequences,

Unit – II

Control Statements: Selection Statements – if, if-else, nested if, nested if-else, comma operator, conditional operator, switch; Iterative Statements–while, for, do-while; Special Control Statement–goto, break, continue, return, exit.

Arrays and Strings: One-dimensional Arrays, Character Arrays, Functions from ctype.h, string.h, Multidimensional Arrays.

Unit – III

Functions: Concept of Function, Using Functions, Call-by-Value Vs Call-by-reference, Passing Arrays to Functions, Score of Variables, Storage Classes, Inline Functions, and Recursion.

Pointers: Introduction, Address of Operator (&), Pointer, Uses of Pointers, Arrays and Pointers, Pointers and Strings, Pointers to Pointers, Array of Pointers, Pointer to Array, Dynamic Memory Allocation.

Unit – IV

User-defined Data Types: Declaring a Structure (Union) and its members, Initialization Structure (Union), Accessing members of a Structure (Union), Array of Structures (Union), Structures verses Unions, Enumeration Types.

Files: Introduction, Using Files in C, Working with Text Files, Working with Binary Files, Files of Records, Random Access to Files of Records, Other File Management Functions.

Suggested Reading:

1. PradipDey, ManasGhosh, *Computer Fundamentals and Programming in C*(2e)

References:

1. Ivor Horton, *Beginning C*
2. Ashok Kamthane, *Programming in C*
3. Herbert Schildt, *The Complete Reference C*
4. Paul Deitel, Harvey Deitel, *C How To Program*
5. Byron S. Gottfried, *Theory and Problems of Programming with C*
6. Brian W. Kernighan, Dennis M. Ritchie, *The C Programming Language*
7. B. A. Forouzan, R. F. Gilberg, *A Structured Programming Approach Using C*

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Programming with C Lab

Practical 2 Hours/Week 1credit

1 Write a program to find the largest two (three) numbers using if and conditional operator.
2 Write a program to print the reverse of a given number.

3 Write a program to print the prime number from 2 to n where n is given by user.
4 Write a program to find the roots of a quadratic equation using switch statement.

5 Write a program to print a triangle of stars as follows (take number of lines from user):

```
*
* * *
*****
*******
*********
```

6 Write a program to find largest and smallest elements in a given list of numbers.
7 Write a program to find the product of two matrices..

8 Write a program to find the GCD of two numbers using iteration and recursion.

9 Write a program to illustrate use of storage classes.

10 Write a program to demonstrate the call by value and the call by reference concepts.

11 Write a program that prints a table indicating the number of occurrences of each alphabet in the text entered as command line arguments.

12 Write a program to illustrate use of data type enum.
13 Write a program to demonstrate use of string functions string.h headerfile.

14 Write a program that opens a file and counts the number of characters in a file.

15 Write a program to create a structure Student containing fields for Roll No., Name, Class, Year and Total Marks. Create 10 students and store them in a file.

16 Write a program that opens an existing text file and copies it to a new text file with all lowercase letters changed to capital letters and all other characters unchanged.

Note : Write the Pseudo Code and draw Flow Chart for the above programs.
Recommended to use Open Source Software : GCC on Linux; Dev C++ (or) CodeBlocks on Windows 10.

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DSC–3

Calculus and Differential Equations

Theory 4 Hours/Week 4 credits

Unit – I

Successive Differentiation - Higher order derivatives - Calculation of nth derivative - Some standard results - Determination of nth derivative of rational functions - the nth derivatives of the products of the powers of sines and cosines - Leibnitz's theorem - the nth derivative of the product of two functions.

Unit – II

Linear Differential Equations - Differential Equations Reducible to Linear form - Exact differential equations - Integrating Factors.

Unit – III

Differential Equations of 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 first degree in x and y - Clairaut's equation - Applications of first order Differential Equations - Growth and Decay - Radioactivity and carbon dating.

Unit – IV

Higher order Linear Differential Equations - Solution of homogeneous linear differential equations - Constant coefficients - Solution of non-homogeneous differential equations P(D)y=Q(x) with constant coefficients by means of polynomial operators when $Q(x) = be^{ax}, b\sin ax, b\cos ax, bx^k, Ve^{ax}$ - Method of variation of parameters - Linear differential equations with non constant coefficients - The Cauchy Euler Equation.

Suggested Reading:

1. Differentail Calculus by Shanti Narayana and P.K.Mittal, S.Chand Publishers, New Delhi
2. Differential Equations and their Applications by Zafar Ahsan, PHI Pvt. Ltd, New Delhi

References:

1. Frank Ayres Jr: Theory and Problems of Differential Equations

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DSC–4

Statistics and Probability Models

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit-I

Statistics: Measures of Central Tendency, Measures of Dispersions, Central and Non-central Moments, their inter-relationships, Measures of Skewness and Kurtosis.

Probability: Basic concepts of Probability with examples, Mathematical, Statistical and Axiomatic definitions of Probability and their merits and demerits. Joint, Marginal and Conditional probabilities; Addition, Multiplication and Bayes' theorems, Problems on Probability.

Unit-II

Random Variables: Discrete and continuous random variables, functions of random variables, probability mass and density functions with illustrations. Distribution function and its properties, bivariate distribution, statements of its properties, Joint, marginal and conditional distributions, Independence of random variables.

Mathematical Expectation: Mathematical expectation of a function of a random variable with examples, Addition and Multiplication theorems of expectation. Definitions of moment generating function, characteristic function, cumulant generating function, probability generating function and statements of their properties with applications, Chebyshev's and Cauchy-Schwartz's inequalities and their applications.

Unit-III

Discrete Distributions: Definitions, mean, median, mode, variance, moment generating function, characteristic function, cumulant generating function, probability generating function and special properties (if any) for the discrete distributions: Binomial, Poisson, Negative binomial, Geometric distributions.

Unit-IV

Continuous distributions: Definitions, mean, median, mode, variance, moment generating function, characteristic function, cumulant generating function, and special properties (if any) for the continuous distributions: Rectangular, Normal, Exponential, Gamma, Beta and Cauchy distributions.

Suggested Reading:

1. V. K. Kapoor and S. C.Gupta:Fundamentals of Mathematical Statistics, S. Chand & Sons.
2. Hogg, Tanis, Rao: Probability and Statistical Inference, (7th edition), Pearson.
3. M. Jagan Mohan Rao and Papa Rao: A Text book of Statistics (Paper-I).
4. Sanjay Arora and Bansilal: New Mathematical Statistics, Satya Prakashan, New Delhi.

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Statistics and Probability Models LAB

(Using MS-Excel)

Practical 2 Hours/Week 1credit

(Basics of Excel- data entry, editing and saving, establishing and copying formulae, built in Functions in excel, copy and paste and exporting to MS word document).

1. Diagrammatic presentation of data (Bar and Pie).
2. Graphical presentation of data (Histogram, Frequency polygon, Ogives).
3. Computation of Measures of Central Tendencies, Dispersions and Coefficients of Dispersions
4. Computation of Moments, Coefficients of Skewness, Kurtosis.
5. Fitting of Binomial distribution - Direct & Recurrence relation methods.
6. Fitting of Poisson distribution - Direct & Recurrence relation methods.
7. Fitting of Negative Binomial distribution - Direct & recurrence relation methods
8. Fitting of Normal distribution - Areas & Ordinates methods.
9. Fitting of Exponential distribution.
10. Fitting of Cauchy distribution.
11. Generation of random samples from Uniform (0,1), Uniform (a,b),
12. Generation of random samples from Binomial, Poisson, Normal and Exponential distributions.

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Semester -II
Computer Organization

DSC–5

Theory 4 Hours/Week 4credits

Unit -I

Digital Logic Circuits: Digital Computers, Logic Gates, Boolean Algebra, Map Simplification, Combinational Circuits, Flip Flops, Sequential Circuits.
Digital Components: Integrated Circuits, Decoder, Multiplexers, 'Registers, Shift Registers, Binary counter, Memory unit.
Data Representation: Data types, Complements, Fixed and Floating Point Representation, Other binary codes and error Detection codes.

Unit -II

Register Transfer and Micro operations: Register Transfer language, Register transfer, Bus and Memory Transfer, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations and Arithmetic logic shift unit.
Basic Computer Organization and Design: Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycles, Memory Reference Instructions, Input, Output and Interrupts, Design of Accumulator logic.
Memory Organization: Memory Hierarchy, Main Memory, Cache Memory.

Unit -III

Programming the Basic Computer: Introduction, Machine Language, Assembly Language, The Assembler, Programming Arithmetic and Logic Operations, Subroutines, and I/O, Programming.
Micro programmed Control: Control Memory, Address Sequencing, Micro program Example, Design of Control Unit.
Input -Output organization: Peripheral Devices, I/O Output interlace, Asynchronous data transfer, Modes 0ftransfer, Priority Interrupt, OMA, Input output Processor, Serial Communication.

Unit -IV

Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, RISC.
Parallel Processing: Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline. Computer Arithmetic: Addition and Subtraction, Multiplication algorithms, Division Algorithms, Floating point arithmetic operations, decimal arithmetic unit, and decimal arithmetic operations.

Suggested Reading:

1. M. Morris Mano, "Computer System Architecture", Pearson Education Asia, Third Edition, 1993.

References:

1. Miles Murdocca, Vincent Heuring, "Computer Architecture and Organization", John Wiley & Sons 2007.
2. Sivarama P Dandamudi "Fundamentals of Computer Organization and Design", Wiley Dream Tech publishers, 2003.
3. William stallings, "Computer Organization & Architecture", Pearson Education, Sixth Edition 2003.
4. G.V.Anjaneyulu "Computer Organization".

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DSC–6 **Problem Solving and Python Programming**

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit-I

Introduction to Computing and Problem Solving: Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudo Code and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms.

Introduction to Python Programming: Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: The if, The if...else,The if...elif...else Decision Control Statements, Nested if Statement, The while Loop, The for Loop, The continue and break Statements.

Unit-II

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Unit-III

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram. **Files and exception:** text files, reading and writing files, format operator; command line arguments,errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

Unit-IV

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance The Polymorphism.

Functional Programming: Lambda. Iterators, Generators, List Comprehensions.

Suggested Reading:

1. Learning To Program With Python. Richard L. Halterman. Copyright © 2011
2. Python for Everybody, Exploring Data Using Python 3. Dr. Charles R. Severance. 2016

References:

1. Introduction to Python Programming. Gowrishankar S., Veena A. CRC Press, Taylor & Francis Group, 2019
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python
3. Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)

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Problem Solving and Python Programming LAB

Practical 2 Hours/Week 1credit

Installing Python and Setting up the Environment

Python interpreter can be downloaded for Windows/Linux platform using the link below:
https://www.python.org/downloads/windows/

Exercises

I. Programs to demonstrate the usage of operators and conditional statements

1. Write a program that takes two integers as command line arguments and prints the sum of two integers.
2. Program to display the information:
Your name, Full Address, Mobile Number, College Name, Course Subjects
3. Program to find the largest number among 'n' given numbers.
4. Program that reads the URL of a website as input and displays contents of a webpage.

II. Programs to demonstrate usage of control structures

5. Program to find the sum of all prime numbers between 1 and 1000.
6. Program that reads set of integers and displays first and second largest numbers.
7. Program to print the sum of first 'n' natural numbers.
8. Program to find the product of two matrices.
9. Program to find the roots of a quadratic equation

III. Programs to demonstrate the usage of Functions and Recursion

10.Write both recursive and non-recursive functions for the following: a. To find GCD of two integers
b. To find the factorial of positive integer
c. To print Fibonacci Sequence up to given number 'n'
d. To convert decimal number to Binary equivalent
11. Program with a function that accepts two arguments: a list and a number 'n'. It should display all the numbers in the list that are greater than the given number 'n'.
12. Program with a function to find how many numbers are divisible by 2, 3,4,5,6,7 between 1 to1000

IV. Programs to demonstrate the usage of String functions

13. Program that accept a string as an argument and return the number of vowels and consonants the string contains.
14. Program that accepts two strings S1, S2, and finds whether they are equal are not.
15. Program to count the number of occurrences of characters in a given string.
16. Program to find whether a given string is palindrome or not

V. Programs to demonstrate the usage of lists, sets, dictionaries, tuples and files.

17. Program with a function that takes two lists L1 and L2 containing integer numbers as parameters. The return value is a single list containing the pair wise sums of the numbers in L1 and L2.
18. Program to read the lists of numbers as L1, print the lists in reverse order without using reverse function.
19. Write a program that combine lists L1 and L2 into a dictionary.
20. Program to find mean, median, mode for the given set of numbers in a list.
21. Program to find all duplicates in the list.
22. Program to o find all the unique elements of a list.
23. Program to find max and min of a given tuple of integers.
24. Program to find union, intersection, difference, symmetric difference of given two sets.
25. Program to display a list of all unique words in a text file
26. Program to read the content of a text file and display it on the screen line wise with a line number followed by a colon
27. Program to analyze the two text files using set operations
28. Write a program to print each line of a file in reverse order.

VI. Programs to demonstrate the usage of Object Oriented Programming

29. Program to implement the inheritance
30. Program to implement the polymorphism

VII. Programs to search and sort the numbers

31. Programs to implement Linear search and Binary search
32. Programs to implement Selection sort, Insertion

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DSC–7 **Algebra**

Theory 4 Hours/Week 4credits

Unit-I

Group Theory: Definition of a Group - Some Examples of a Groups - Some Preliminary Lemmas - Subgroups - A Counting Principle.

Unit-II

Normal Subgroups and Quotient Groups – Homomorphisms.

Unit-III

Ring Theory: Definition and Examples of Rings - Some Special Classes of Rings - Homomorphisms

Unit-IV

Ideals and Quotient Rings - More Ideals and Quotient Rings - Euclidean Rings.

Suggested Reading:

- Topics in Algebra by I.N.Herstein 2nd Edition, John Wiley & Sons

References:

1. Contemporary Abstract Algebra by Joseph A Gallion (9th edition)
2. Fraleigh J.B, A First Course in Abstract Algebra

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DSC–8

Statistical Inference

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit-I

Sampling Distributions: Concepts of Population, Parameter, Random sample, Statistic, Sampling distribution and Standard error. Standard error of sample mean(s) and sample proportion(s). Exact sampling distributions: Statement and properties of $\chi 2$, t and F distributions.

Point estimation: Estimation, criteria of a good estimator- consistency, unbiasedness, efficiency and sufficiency with examples. Deriving sufficient statistics for Binomial, Poisson, Normal and Exponential (one parameter only) distributions. Estimation by the method of moments, Maximum likelihood estimation (MLE), Concept of interval estimation.

Unit-II

Testing of Hypothesis: Concepts of statistical hypotheses, Statement of Neyman-Pearson's lemma, Examples in case of Binomial, Poisson, Exponential and Normal distributions and their power of the test functions.
Large sample tests: single sample mean, difference of means, single sample proportion, difference of proportions and difference of standard deviations.

Unit-III

Small sample tests: Tests of significance based on $\chi 2$: for specified variance, goodness of fit and test for independence of attributes. Tests of significance based on student's-t: test for single sample specified mean, difference of means for independent and related samples. F - test for equality of population variances.

Unit-IV

Non-parametric tests: Their advantages and disadvantages, comparison with parametric tests. Measurement scale - nominal, ordinal, interval and ratio. Use of Central Limit Theorem in testing. One sample runs 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 runs test. Use of central limit theorem in testing.

Suggested Reading:

1. V.K. Kapoor and S.C. Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi
2. Sanjay Arora and Bansi Lal: New Mathematical Statistics Satya Prakashan , New Delhi
3. Siegal, S., and Sidney: Non-parametric statistics for Behavioral Science. McGraw Hill.
4. Gibbons J.D and Subhabrata Chakraborti: Nonparametric Statistical Inference. Marcel Dekker.
5. Conover: Practical Nonparametric Statistics. Wiley series.
6. Hogg, Tanis, Rao. Probability and Statistical Inference.7th edition. Pearson Publication.

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Statistical Inference LAB

(Using R)

Practical 2 Hours/Week 1credit

1. Data Visualization using: Bar diagram, Pie diagram, Histogram, Frequency polygon, Ogives.
2. Computation of Measures of Central Tendencies, Dispersions and Coefficients of Dispersions
3. Computation of Moments, Coefficients of Skewness, Kurtosis.
4. Generation of random samples from Uniform (0,1), Uniform (a, b),
5. Generation of random samples from Binomial, Poisson, Normal and Exponential distributions
6. Small/large sample tests for: single sample mean, two / paired sample means, Small / large sample test for single and difference of variances.
7. $\chi 2$-test for goodness of fit and independence of attributes.
8. Nonparametric tests for single and related samples (sign test and Wilcoxon signed rank test) and one sample runs test.

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Semester -III

SEC–1 **Linux Tools and Utilities**

Theory 2 Hours/Week 2credits

Unit-I

1. Introduction to Linux Tools and Command Line
   - Overview of Linux command line
   - Basic command-line navigation and file manipulation
2. Text Processing Tools
   - grep, sed, and awk for text searching and manipulation
   - Regular expressions for pattern matching
3. File Management Tools
   - cp, mv, rm, mkdir, rmdir for file and directory operations
   - Working with permissions and ownership
4. Process Management and System Monitoring
   - ps, top, htop for process management and monitoring
   - kill and signals for process control
5. Package Management
   - apt and yum for package installation and management
   - Dependency handling and system updates

Unit-II

6. Networking Tools
   - ifconfig, ip, ping, netstat for network configuration and diagnostics
   - Working with SSH and remote access
7. Version Control with Git
   - Introduction to version control concepts
   - Using Git for tracking changes and collaborating on projects
8. System Administration and Automation
   - Cron jobs for scheduling tasks
   - Shell scripting fundamentals
9. Debugging and Troubleshooting Tools
   - gdb for debugging programs
   - strace and ltrace for tracing system calls and library calls
10. Text Editors and IDEs
    - Introduction to text editors like Vim and Nano
    - Using Integrated Development Environments (IDEs) on Linux

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DSC–9

Data Structures and Algorithms

Theory 4 Hours/Week 4credits

Unit-I

Performance and Complexity Analysis: Space Complexity, Time Complexity, Asymptotic Notation (Big-Oh), Complexity AnalysisExamples.
Linear List-Array Representation: Vector Representation, Multiple Lists Single Array. Linear List-Linked Representation: Singly Linked Lists, Circular Lists, Doubly Linked Lists, Applications (Polynomial Arithmetic).
Arrays and Matrices: Row and Column Major Representations, Sparse Matrices.
Stacks: Array Representation, Linked Representation, Applications (Recursive Calls, Infix to Postfix, Postfix Evaluation).
Queues: Array Representation, Linked Representation.
Skip Lists and Hashing: Skip Lists Representation, Hash Table Representation, Application- Text Compression.

Unit-II

Trees: Definitions and Properties, Representation of Binary Trees, Operations, Binary Tree Traversal.
Binary Search Trees: Definitions, Operations on Binary Search Trees.
Balanced Search Trees: AVL Trees, and B-Trees.

Unit-III

Graphs: Definitions and Properties, Representation, Graph Search Methods (Depth First Search and Breadth First Search)
Application of Graphs: Shortest Path Algorithm (Dijkstra), Minimum Spanning Tree (Prim's and Kruskal'sAlgorithms).

Unit-IV

Searching : Linear Search and Binary Search Techniques and their complexity analysis.
Sorting and Complexity Analysis: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, and Heap Sort.
Algorithm Design Techniques: Greedy algorithm, divide-and-conquer, dynamic programming.

Suggested Reading:

1. Michael T. Goodrich, Roberto Tamassia, David M. Mount, Data Structures and Algorithms Python John Wiley & Sons,2013.
2. Mark Allen Weiss, Data Structures and Problem Solving using C++, Pearson Education International,2003.
3. SartajSahni, Data Structures--Algorithms and Applications in C++, 2nd Edition Universities Press (India) Pvt. Ltd.,2005.

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DSC–10

Object Oriented Programming using Java

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit-I

Object Oriented System Development: Understanding Object Oriented Development, Understanding Object Oriented Concepts, Benefits of Object Oriented Development.
Java Programming Fundamentals: Introduction, Overview of Java, Data types, Variables and Arrays, Operators, Control Statements, Classes, Methods, Inheritance, Packages and Interfaces.

Unit-II

I/O basics: Stream and Byte classes, Character Streams, Reading Console input and output, Print Writer Class, String Handling, Exceptions Handling, Multithreaded Programming.

Unit-III

Exploring Java Language, Collection Overview, Collections Interfaces, Collection Classes, Iterators, Random Access Interface, Maps, Comparators, Arrays, Legacy classes and Interfaces, String Tokenizer, Bit Set, Date, Calendar observable, Timer.

Unit-IV

Introducing AWT working With Graphics: AWT Classes, Working with Graphics.
Event Handling: Two Event Handling Mechanisms, The Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces.
AWT Controls: Control Fundamentals, Labels, Using Buttons, Applying Check Boxes, CheckboxGroup, Choice Controls, Using Lists, Managing Scroll Bars, Using TextField, Using TextArea, Understanding Layout Managers, Menu bars and Menus, Dialog Boxes, FileDialog, Handling events by Extending AWT Components, Exploring the controls, Menus and Layout Managers.

Suggested Reading:

1. Herbert Schildt, The Complete Reference Java, 10th Edition, Tata McGraw Hill, 2017.
2. Bruce Eckel, Thinking in Java, 4th Edition, Pearson Education
3. Dietel and Dietel, Java: How to Program, 5th Edition, Prentice Hall
4. James M Slack, Programming and Problem solving with JAVA, Thomson
5. C Thomas Wu, An Introduction to Object Oriented programming with Java, Tata McGraw Hill, 2005.
6. Kathy Sierra, Bert Bates ,Head First Java, 2nd Edition, A Brain-Friendly Guide, Publisher: O'Reilly Media, February 2005.

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Programming in Java Lab

Practical 2 Hours/Week 1credit

1. A program to illustrate the concept of class with constructors, methods and overloading.
2. A program to illustrate the concept of inheritance and dynamic polymorphism.
3. A program to illustrate the usage of abstract class.
4. A program to illustrate multithreading.
5. A program to illustrate thread synchronization.
6. A program to illustrate Exception handling.
7. A program to illustrate user-defined Exceptions
8. A program to demonstrate use of User-defined Packages.
9. A program using String Tokenize.
10. A program using Linked list class
11. A program using Tree Set class
12. A program using Hash Set and Iterator classes
13. A program using Map classes.
14. A program using Enumeration and Comparator interfaces.
15. A program using File and Filename Filter
16. Program using Data class.
17. An application involving GUI with different controls, menus and event handling.
18. A program to implement an applet.

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DSC–11 **Discrete Mathematics**

Theory 4 Hours/Week 4 credits

Unit-I

Propositional logic: Propositional Equivalences, Predicates and Quantifiers, Rules of Inference– Valid Arguments in Propositional Logic Rules of Inference for Quantified Statements. Introduction to Proofs–Direct Proofs, Proofs by Contraposition, Proofs by Contradiction.
Boolean Algebra – Boolean Functions and Boolean Expressions, Identities of Boolean Algebra, Representing Boolean Functions. Logic Gates, Minimization of Circuits–K-maps.

Unit-II

Combinations and Permutations: Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions. The Principle of Inclusion – Exclusion and its Applications.

Unit-III

Recurrence Relations: Generating Functions of Sequences, Generating Function Models, Calculating Coefficients of Generating Functions. Solutions of Recurrence Relations, the Fibonacci Relation. Solving Recurrence Relations by Substitution and by Generating Functions, Method of Characteristic Roots. Solution of Inhomogeneous Linear Recurrence Relations, the Method of Undetermined Coefficients: Solving Nonlinear Recurrence Relations.

Unit-IV

Graphs: The Hand shaking Theorem, Representing Graphs and Graph Isomorphism. Connectivity,Euler and Hamiltonian Paths and Circuits,Shortest Path Problems, Dijkstra's Algorithm,Planar Graphs,Eulerformula.
Trees: Introduction to Trees, Tree Traversal. Spanning Trees, DFS, BFS Algorithms,Minimum Spanning Trees. Prim's and Kruskal's Algorithms.

Suggested Reading:

1. Discrete Mathematics and its Applications by Kenneth H Rosen, Seventh Edition, McGraw Hill Education (India) Private Ltd, New Delhi.
2. Discrete Mathematics for Computer Scientists & Mathematicians by Joe L.Mott, Abraham Kandel and Theodore P. Baker, Second Edition, Prentice Hall of India, Ltd, New Delhi.

References:

1. Elements of Discrete Mathematics by CLLiu and D.P.Mohapatra, Third Edition, The Mc Graw-Hill Companies.
2. Discrete and Combinatorial Mathematics by Ralph P. Grimaldi and B.V.Ramana,5thEdition, PEARSON Education.

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DSC–12

Statistical Methods

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit-I

Correlation & Regression: Bivariate data, Scattered diagram, Concept of correlation, computation of Karl-Pearson correlation coefficient for grouped and ungrouped data and its properties. Correlation ratio, Spearman's rank correlation coefficient and its properties. Simple linear regression, Principle of least squares, fitting of linear regression, correlation verses regression, properties of regression coefficients.

Unit-II

Sampling: Concepts of population, sample, sampling unit, parameter, statistic, sample frame and standard error. Principal steps in sample surveys - need for sampling, census versus sample surveys, sampling and non- sampling errors, sources and treatment of non-sampling errors, advantages and limitations of samplings. Types of sampling: Subjective, probability and mixed sampling methods. Methods of drawing random samples with and without replacement. Estimates of population mean, total, and proportion, their variances and the estimates of variances in Simple Random Sampling with and without replacement (with proofs). Estimates of population mean, total, and proportion, their variances Stratified and Systematic sampling methods (statements only), Advantages and disadvantages of SRS, Stratified and Systematic sampling methods. Comparison of relative efficiencies.

Unit-III

Time Series: Time series and its components with illustrations, additive, multiplicative and mixed models. Determination of trend by least squares and moving average methods. Growth curves and their fitting with reference to Modified exponential, Gompertz and Logistic curves. Determination of seasonal indices by Ratio to moving average, ratio to trend and link relative methods.
Index Numbers: Concept, construction, uses and limitations of simple and weighted index numbers. Laspeyer's, Paasche's and Fisher's index numbers, criterion of a good index numbers, problems involved in the construction of index numbers. Fisher's index as an ideal index number. Fixed and chain base index numbers. Cost of living index numbers and wholesale price index numbers. Base shifting, splicing and deflation of index numbers.

Unit-IV

Analysis of Variance: Analysis of Variance (ANOVA), one-way, two-way classifications with one observation per cell and its Statistical analysis.
Design of Experiments: Principles of experimental designs, Analysis of Completely randomized Design, Randomized Block Design, Latin Square Design including one missing observation, expectation of various sum of squares. Comparison of the efficiencies of above designs.

Suggested Reading:

1. V. K. Kapoor and S. C. Gupta: Fundamentals of Mathematical Statistics, S. Chand & Sons.
2. V.K.Kapoor and S.C. Gupta: Applied Statistics, Sultan Chand & Sons,
3. Daroga Singh and Chowdhary: Theory and Analysis of Sample survey designs. Wiley Eastern

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Statistical Methods LAB (Using R)

Practical 2 Hours/Week 1credit

1. Fitting of straight line and parabola by the method of least squares.
2. Fitting of power curves of the type y= a xb, y=a bx and y=a ebx by the method of least squares.
3. Computation of correlation coefficient, forming regression lines using MS Excel.
4. Computation of multiple and partial correlation coefficients using MS Excel.
5. Measurement of trend by method of least squares and moving averages.
6. Determination of seasonal indices by the method of Ratio to moving averages.
7. Determination of seasonal indices by the method of Ratio to trend.
8. Determination of seasonal indices by the method of link Relatives.
9. Measurement of trend by method of least squares and moving averages.
10. Determination of seasonal indices by the method of Ratio to moving averages.
11. Determination of seasonal indices by the method of Ratio to trend.
12. Determination of seasonal indices by the method of link Relatives.
13. Analysis of Completely Randomized Design.
14. Analysis of Randomized Block Design.
15. Analysis of Latin Square Design.

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Semester -IV
Mini Project

SEC–2

Practical 4 Hours/Week 2credits

The department can initiate the project allotment procedure at the end of III semester and finalize the following in the first two weeks of IV semester:

- The department should appoint a project coordinator (who will coordinate the following)
- Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)
- Grouping of students (max 3 in a group)
- Allotment of project guides

The aim of mini project is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. To get awareness on current problems and solution techniques, Project coordinator shall arrange special lectures during the first 2 weeks of IV semester by inviting faculty members, professionals from industries and R&D institutions. Further, these lectures may be conducted anytime during the semester to enable the students to gather information on problems and industry practices. At the end of 2nd week, each group with the help of guide shall formalise the project proposal with problem definition, literature survey, probable solution etc. The coordinator shall prepare seminar schedule for all the students(batch wise) from the 5th week to the last week of the semester which should be strictly adhered to.

Each group will be required to:
1. Submit a one page synopsis before the seminar for display on notice board.
2. Give a 30 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the talk.

The students present a seminar and submit a seminar report that should include the following components of the project:

- Problem definition and specification
- Literature survey
- Design and Implementation Plan

At the end of the Semester, the students should write a project report on the work carried out and submit the same duly signed by the guide to the project coordinator. A viva-voce exam has to be conducted by internal members of the department to assess the project work carried out. At least two teachers will be associated with the Mini Project to evaluate the performance of students for the award of sessional marks.

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DSC–13 **Operating Systems**

Theory 3 Hours/Week 3credits

Unit -I

Introduction: Definition of Operating System, Computer-System Organization, Computer System Architecture, Operating-System Structure, Operating System Structures: Operating- System Services, System Calls, Types of System Calls.
Process: Process Concept, Process Scheduling, Operations on Processes, Inter process Communication, Threads: Overview, Multi core Programming, Multithreading Models, Threading Issues. CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms

Unit -II

Process Synchronization: Background, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors.
Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Unit -III

Main Memory: Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table.
Virtual Memory: Background, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, Mass-Storage Structure, Overview of Mass- Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Formatting, RAID Structure.

Unit -IV

File-System Interface: File Concept, Access Methods, Directory and Disk Structure, Protection.
File-System Implementation: File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance.
I/O Systems: Overview, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Requests to Hardware Operations.

Suggested Readings

1. Abraham Silberschatz, Peter Galvin, Greg Gagne, "Operating System Concepts", Ninth Edition, John wiley and sons publication, 2013.

References:

1. A.Tanenbaum,"Modern Operation Systems", Third Edition, Pearson Education, 2008.
2. William Stallings, "Operating Systems", Fifth Edition, Pearson Education, 2005.
3. Ida M.Flynn, "Understanding Operating Systems", Sixth Edition, Cengage, 2011.
4. D.M.Dhamdhere,"Operating systems a concept based approach", Second Edition, McGraw-Hill, 2007

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DSC–14

Database Management Systems

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit -I

Database Environment - concepts and definitions, Traditional file processing systems, Database approach, Range of database applications, Advantages, Components, Three schema Architecture, Database Analysis , E-R Model - Entities, Attributes, Relationships, Degree and Cardinality. Enhanced ER Model -Specialization and Generalization, Constraints, Conceptual Design with the ER Model.
Relational model - Definitions, Integrity constraints, Transforming EER diagrams into Relations, Normalization - Normal forms.

Unit -II

Relational Algebra and Calculus: Preliminaries, Relational Algebra, Relational Calculus, Expressive Power of Algebra and Calculus.
SQL: Queries, Constraints, The Form of Basic SQL Query, Set Operators, Nested Queries, Aggregate Operators, Procedures and functions, Triggers

Unit -III

Overview of Storage and Indexing: File Organizations and Indexing, Index Data Structures, Comparison of File Organizations.
Tree-Structured Indexing: Indexed Sequential Access Method (ISAM), B+ Trees, Search, Insert Delete, B+ Trees in Practice.
Hash-Based Indexing: Static Hashing, Extendible Hashing, Linear Hashing, Extendible versus Linear Hashing.

Unit -IV

Transaction Management: ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control. Concurrency Control: 2PL, Serializability, and Recoverability, Introduction to Lock Management, Dealing with Deadlock.
Crash Recovery: Introduction to ARIES, Recovering from a System Crash, Media Recovery.

Suggested Readings

1. Fred R Me Fadden. Jeffrey A Hoffer, Mary B Prescott - Modern Database Management, Fifth edition. Addition Wesly 1999
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", Third Edition, McGraw Hill, 2003

References:

1. Abraham Silberschatz, Henry F Korth, S Sudharshan, "Database System Concepts", Sixth Edition, McGraw-Hill International Edition, 2011
2. Ramez Elmasri, Durvasul VLN Somayajulu, Shamkant B. Navathe, Shyam K Gupta, " Fundamentals of Database Systems", Fourth Edition, Pearson Education, 2006

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Database Management Systems LAB

Practical 2 Hours/Week 1credit

1. Create command for creating a table using primary key
2. Alter command for altering the column name and data type of a column in the table
3. Alter command to add new column to the existing table
4. Alter command to modify the existing name of the column in the table
5. Drop command of the table
6. Truncate command for the table
7. Insert command for storing the records in the database table
8. Update command for updating a particular record by using where clause
9. Delete command for removing a particular record from the table
10. Select command for selecting data from the table
11. Select command for selecting the specific data from the data by using where clause and select distinct statement
12. Select command for selecting the records by using ORDER BY clause ASC
13. Select command for selecting the records by using ORDER BY clause DESC
14. SQL Built in functions (MIN. MAX, COUNT, AVG, SUM)
15. SQL Query to perform AND Operator and OR Operator
16. SQL Query to perform GROUPBY Clause
17. SQL Query to perform HAVING Clause
18. SQL I Queries to perform integrity constraints
19. SQL Query to perform SQL BETWEEN Operator
20. Joins – Equi Join, Non-Equi Join, Outer Join and Self Join
21. Stored Procedures
22. Triggers

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DSC–15

Real Analysis

Theory 4 Hours/Week 4 credits

Unit -I

Real Sequences - Sequences - Limit Points of a Sequence - Limits - Inferior and Superior - Convergent Sequences - Non Convergent Sequences - Cauchy's General Principle of Convergence - Algebra of Sequences - Some important Theorems - Monotonic Sequences.

Unit -II

Infinite series - Introduction - Positive term Series - Comparison Tests for positive term series - Cauchy's Root Test - D' Alembert's Ratio Test - Alternating series.

Unit -III

Functions of a single variable - Limits - Continuous functions - Functions Continuous on closed intervals - Uniform Continuity.

Unit -IV

The Derivative - Continuous Functions - Increasing and Decreasing Functions - Darboux's Theorem - Rolle's Theorem - Lagrange's mean value theorem - Cauchy's mean value theorem.

Suggested Readings

1. Mathematical Analysis by S.C. Malik; Savita Arora, New Age International Publishers.

References:

1. Elementary Analysis by Kenneth. A. Ross, 2nd Edition, Springer.
2. Mathematical Analysis, Shanti Narayana and Mittal, S.Chand Publishers, New Delhi

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DSC–16

Optimization Techniques

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit -I

Operations Research: Meaning and scope of OR. Convex sets and their properties. Definition of general LPP. Formulation of LPP. Solution of LPP by graphical method. Statements of Fundamental theorem of LPP and other related theorems. Simplex algorithm.
Concept of artificial variables: Big –M /Penalty method and two-phase simplex methods. Concept of degeneracy and resolving it.

Unit -II

Concept of duality of LPP. Dual Primal relationship, Statement of Fundamental Theorem of Duality. Definition of transportation problem, TPP as a special case of LPP, Initial basic feasible solutions by North-West Corner Rule, Matrix minimum method and VAM. Optimal solution through MODI tableau and stepping stone method for balanced and unbalanced transportation problem.

Unit -III

Degeneracy in TP and resolving it. Concept of Transshipment problem. Formulation and description of Assignment problem and its variations. Assignment problem as special case of TP and LPP. Unbalanced assignment problem, optimal solution using Hungarian method and Traveling salesman problem and its solution.
Problem of Sequencing. Optimal sequence of N jobs on two and three machines without passing.

Unit -IV

Basic concepts of Networks constraints: Construction of Network and critical path; PERT and CPM; Inventory: Introduction; ABC analysis and Deterministic Inventory models with and without shortages.

Suggested Readings

1. Kanti Swaroop, P.K.Gupta and ManMohan: Operations Research. Sultan Chand.
2. S.D. Sharma: Operations Research
3. J.K. Sharma: Operations Research Theory and Applications. Macmillan Publishers India LTD.
4. Parikriya Parishodhana - Telugu Academy.

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Optimization Techniques LAB (Using R)

Practical 2 Hours/Week 1credit

1. Solution of L.P. problem by Graphical method
2. Solution of L.P. problem by simplex method
3. Solution of L.P. problem by the dual problem from Optimal Simplex table.
4. Solution of L.P. problem by Big-M Method.
5. Solution of L.P. problem by Two-phase simplex method.
6. IBFS for a transportation problem by North-West corner rule, Matrix minimum method and Vogel's approximation method and also Optimum solution to balanced and unbalanced transportation problem by MODI method.
7. Optimum solution to balanced and unbalanced Assignment problem by Hungarian method and also Solution of traveling salesman problem.
8. Computation of Optimal Sequence and idle time for N jobs on 2 and 3 machines.

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Semester –V

SEC–3 **Number Theory**

Theory 2 Hours/Week 2 credits

Unit -I

The Goldbach conjecture - Basic properties of congruences - Binary and Decimal Representation of Integers - Number Theoretic Functions; The Sum and Number of divisors - The Mobius Inversion Formula - The Greatest intger function.

Unit -II

Euler's generalization of Fermat's Theorem: Euler's Phi-function - Euler's Theorem some properties of the Euler's Phi-function.

Suggested Readings

1. David M Burton, Elementary Number Theory (7e), McGraw Hill, New Delhi

References:

1. Thomas Koshy, Elementary Number Theory with Applications, Academic Press.
2. Kenneth H Rosen, Elementary Number Theory and its Applications. Pearson Publishers.

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GE–1

Fundamentals of Cyber Security

Theory 4 Hours/Week 4credits

Unit -I

Introduction to Information Security : Attacks, Vulnerability,Security Goals, Security Services and mechanisms
Conventional Cryptographic Techniques: Conventional substitution and transposition ciphers, One-time Pad, Block cipher and Stream Cipher, Steganography

Unit –II

Symmetric and Asymmetric Cryptographic Techniques :DES, AES, RSA algorithms
Authentication and Digital Signatures: Use of Cryptography for authentication, Secure Hash function,
Key management –Kerberos

Unit -III

Program Security : Nonmalicious Program errors –Buffer overflow, Incomplete mediation, Time-of-check to Time-of- use Errors, Viruses, Trapdoors, Salami attack, Man-in-the-middle attacks, Covert channels

Unit -IV

Security in Networks : Threats in networks, Network Security Controls – Architecture, Encryption, Content Integrity, Strong Authentication, Access Controls, Wireless Security, Honeypots, Traffic flow security, Firewalls – Design and Types of Firewalls, Personal Firewalls, IDS, Email Security – PGP,S/MIME

Suggested Readings

1. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
2. Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson
3. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
4. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall.

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DSC–17

Artificial Intelligence

Theory	3 Hours/Week	3credits
Tutorial	1 Hours/Week	1credit

Unit -I

Overview of Artificial Intelligence: Introduction. The Turing Test, Strong AI versus Weak AI, Heuristics, Identifying Problems Suitable for AI, Applications and Methods, Early History of AI, Recent History of AI to the Present, AI in the New Millennium
Uninformed Search: Introduction: Search in Intelligent Systems, State-Space Graphs, Generate-and-Test Paradigm, Blind Search Algorithms, Implementing and Comparing Blind Search Algorithms.

Unit -II

Informed Search: Introduction, Heuristics, Informed Search Algorithms–Finding Any Solution, The Best-First Search, The Beam Search, Additional Metrics for Search Algorithms, Informed Search–Finding an Optimal Solution
Search Using Games: Introduction, Game Trees and Minimax Evaluation, Minimax With Alpha-Beta Pruning,

Unit -III

Logic in Artificial Intelligence: Introduction, Logic and Representation, Propositional Logic, Predicate Logic – Introduction, Several Other Logics, Uncertainty and Probability. Knowledge **Representation:** Introduction, Graphical Sketches and the Human Window, Graphs and the Bridges of Königsberg Problem, Search Trees, Representational Choices, Production Systems, Object Orientation, Frames, Semantic Networks.

Unit -IV

Production Systems: Introduction, Background, Production Systems and Inference Methods, Production Systems and Cellular Automata, Stochastic Processes and Markov Chains, Basic Features and Examples of Expert Systems.

Suggested Readings

1. Stephen Lucci, Danny Kopec. Artificial Intelligence in the 21st Century. A Living Introduction. Mercury Learning and Information. 2nd Edition. 2016

References:

2. Russell,Norvig:ArtificialIntelligence,AModernApproach,PearsonEducation,SecondEdition. 2004
3. Rich,Knight,Nair:ArtificialIntelligence,TataMcGrawHill,ThirdEdition2009
4. SarojKaushik.ArtificialIntelligence.CengageLearning.2011

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DSC–18

Web Programming

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit -I

Introduction to World Wide Web, Web Browsers, Web Servers, Uniform Resource Locators, HTTP. HTML5: Introduction, Links, Images, Multimedia, Lists, Tables, Creating Forms, Styling Forms.
Introduction to XML, XML document structure, Document Type Definition, Namespaces, XML Schemas, Displaying raw XML documents, Displaying XML documents with CSS, XPath Basics, XSLT, XML Processors.

Unit -II

Introduction to Java script, Java Script and Forms Variables, Functions, Operators, Conditional Statements and Loops, Arrays DOM, Strings, Event and Event Handling, Java Script Closures. **Introduction to Ajax**, Pre-Ajax Java Script Communication Techniques, XML HTTP Request Object, Data Formats, Security Concerns, User Interface Design for Ajax.

Unit -III

Java Servlets: Java Servlets and CGI Programming, Benefits of Java Servlet, Life Cycle of Java Servlet, Reading data from client, HTTP Request Header, HTTP Response Header, working with Cookies, Tracking Sessions.
Java Server Pages: Introduction to JSP, JSP Tags, Variables and Objects, Methods, Control Statements, Loops, Request String, User Sessions, Session Object, Cookies.

Unit -IV

Introduction to PHP: Overview of PHP, General Syntactic Characteristics, Primitives, Operations, Expressions, Control Statements, Arrays, Functions, Pattern matching, Form handling, Files, Cookies, Session Tracking. Database access through Web: Architectures for Database Access- Database access with Perl - Database access with PHP-Database access with JDBC.

Suggested Readings

1. Robert W.Sebesta, Programming the World Wide Web, 3rd Edition, Pearson Education, 2006
2. Wendy Willard, HTML5, McGraw Hill Education (India) Edition, 2013
3. Thomas Powell, The Complete Reference: Ajax, Tata-McGraw-Hill, 2011
4. John Pollock, Java Script, 4th Edition, McGraw Hill Education (India) Edition, 2013
5. Jim Keogh, J2EE : The Complete Reference, Tata-McGraw-Hill, 2002

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Web Programming LAB

Practical 2 Hours/Week 1credit

1. Program to illustrate class, objects and constructors
2. Program to implement overloading, overriding, polymorphism etc
3. Program to implement the usage of packages
4. Program to create a user defined exception
5. Program for handling file operation
6. Implement the concept of thread programming
7. Program to implement Generic class and generic methods
8. Applet program for passing parameters
9. Applet program for running an audio file
10. Program for event-driven paradigm in Java
11. Event driven program for Graphical Drawing Application
12. Program that uses Menu driven Application
13. Program to implement JDBC in GUI and Console Application
14. Web page design using HTML and client side validation using Javascript
15. Programs to implement session Handling and Cookies in Servlets and JSP
16. Develop a multi-threaded GUI application of your choice.
17. Program to implement JDBC in a web application

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DSC–19 **Linear Algebra**

Theory 4 Hours/Week 4 credits

Unit -I

Vector Spaces: Vector spaces - Subspaces - Span of a Set - More about Subspaces - Linear Dependence - Independence - Dimension and Basis.

Unit -II

Linear Transformations: Definition and Examples - Range and Kernel of a Linear Map - Rank and Nullity - Inverse of a Linear Transformation - Consequences of Rank - Nullity Theorem - The Space L(U,V) - Composition of Linear Maps.

Unit -III

Matrices : Matrix Associated with a Linear Map - Linear Map Associated with a Matrix - Linear Operations in Mm,n - Matrix Multiplication - Rank and Nullity of a Matrix - Transpose of a Matrix and Special types of Matrices.

Unit -IV

Inner Product Spaces - Orthogonal and Unitary Matrices.

Suggested Readings

1. An Introduction to Linear Algebra by V. Krishna Murthy, V.P. Mainra, J.L. Arora, EWP, New Delhi.

References:

2. Linear Algebra by Stephen H. Friedberg, Arnord J Insel, Lawrence E Spence, Pearson Pub.
3. Linear Algebra and its Applications by David.C.Lay, Addision Wesley Pub. Comp.

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DSC–20 **Data Modelling through Machine Learning Techniques**

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit -I

Introduction to data types, Measurement of scales, understanding data with descriptive statistics and understanding the data with Visualization and data pre-processing (data cleaning, Outlier identification/outliers' treatment, Identifying missing values/ missing value treatment, transformation). Introduction to statistical hypothesis concepts, Understanding relationship between variables using Parametric / Non Parametric tests (Correlations, Chi square, t-tests for proportions, t test for means and F tests. Non parametric tests like sign, Wilcoxon sign, rank test, Kruskal-Wallis test, Friedman test) , data transformations (Standardize, Normalize, converting data from one scale to other scales) and Feature Selection Methods.

Unit -II

Limits of Learning: What does it mean to learn, Some canonical Learning Problems, Not Everything is learnable, Separation of training and test Data, Models, parameters and Hyperparameters, Concepts of Model evolution, over fitting, under fitting, cross validation concepts, (train/test, K fold and Leave out one approaches), Model Performance concepts for classification techniques (classification matrix, Precision and Recall, F1 score, Sensitivity, Specificity, ROC curve) and Model performance concepts for regression (MSE, RMSE, R2, MAPE), Real World Applications of Machine Learning. Concepts of Model improvement (Tuning parameters using manual search, Manual grid search, random search) and saving models for future use.

Unit -III

Introduction to Modeling concepts, review of the modeling process, Concepts of unsupervised and Supervised Modeling, detail approaches of unsupervised models (Hierarchical cluster analysis, K-means Cluster Analysis, data reduction techniques) and details approaches of supervised models (Simple and Multiple Regression, Simple Logistic, Multinomial Logistic, Decision Trees, Neural Networks, KNN, Random Forest, XG-Boost, Ada-Boost and concepts of Ensemble methods.

Unit -IV

Linear Models: The Optimization Framework for Linear Models, Convex Surrogate Loss Functions, Weight Regularization, Support Vector Machine, Optimization and Gradient Descent. Probabilistic Modeling: Classification by Density Estimation, Statistical Estimation, Naïve Bayes Models, Prediction

Suggested Readings

1. Foster Provost & Tom Fawcett, Data science for Business, O'REILLY Publications
2. Henrik Brink, Joseph W. Richards. Mark Fetherolf, Real World Machine Learning, Manning Publications
3. Charu C Agrawal, Data Mining, Springer Publications
4. Trevor Hastie & Robert Tibshirani, An introduction to statistical learning with R, Springer Publications
5. Brett Lantz , Machine Learning with R, Packt Publications

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Data Modelling through Machine Learning Techniques LAB (Using Python)

Practical 2 Hours/Week 1credits

Write programs in Python to do the following:

1. Find rank of the given matrix, eigenvalues and eigenvectors of the given matrix.
2. Find the mean, median, standard deviation and mode using user defined functions.
3. Create a data frame with columns at least 5 observations
   a. Retrieve a particular column from the DataFrame
   b. Summarize the data frame and observe the statistics of the DataFrame created
   c. Observe the mean and standard deviation of the data frame and print the values.
4. Implement the Linear Regression for a sample training data set stored as a .CSV file. Compute Mean Square Error by considering few test data sets.
5. Implement the Non-linear Regression for a sample training data set stored as a .CSV file. Compute Mean Square Error by considering few test data sets.
6. Implement the Logistic Regression for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier.
7. Implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
8. Implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.
9. Implement Support Vector Machine algorithm to classify the iris data set. Print both correct and wrong predictions.
10. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
11. Demonstrate the working of the decision tree based CART algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
12. Calculate the accuracy, precision, and recall for your data set. Assume a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task.
13. Implement a single neural network and test for different logic gates.
14. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

References:

1. Vijayvargia, Abhishek, Machine Learning with Python: An Approach to Applied Machine Learning, BPB Publications, 1stedition,2018.
2. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn and TensorFlow, Oreilly, March 2017.
3. Dr. M Gopal, Applied Machine Learning, 1st Edition, McGraw-Hill,201

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Experiment 1: Data Preprocessing
Objective: Understand the importance of data preprocessing in machine learning.
Data Cleaning: Remove missing values and outliers from a dataset using Python libraries.
Feature Scaling: Apply techniques like Min-Max Scaling and Standardization to normalize numerical features.
Categorical Encoding: Encode categorical variables using techniques like One-Hot Encoding and Label Encoding.
Feature Transformation: Perform transformations like logarithm and square root on skewed features.
Experiment 2: Regression Models
Objective: Learn about basic regression models and their application.
Linear Regression: Build a linear regression model to predict a continuous target variable.
Polynomial Regression: Extend linear regression using polynomial features for nonlinear relationships.
Regularization: Implement Lasso and Ridge regression for feature selection and regularization.
Experiment 3: Classification Models
Objective: Explore classification algorithms and their implementation.
Logistic Regression: Create a logistic regression model for binary classification.
Decision Trees: Build and visualize a decision tree classifier.
Random Forest: Construct a random forest classifier for improved performance and feature importance analysis.
Experiment 4: Model Evaluation and Selection
Objective: Understand methods to assess and compare model performance.
Train-Test Split: Split data into training and testing sets for model evaluation.
Cross-Validation: Implement k-fold cross-validation to estimate model performance.
Model Selection: Compare multiple models using metrics like accuracy, precision, recall, and F1-score.
Experiment 5: Clustering
Objective: Introduce unsupervised learning and clustering techniques.
K-Means Clustering: Apply K-Means algorithm to cluster data points into groups.
Hierarchical Clustering: Perform hierarchical clustering and visualize the dendrogram.
Experiment 6: Dimensionality Reduction Objective: Learn about dimensionality reduction techniques.
Principal Component Analysis (PCA): Reduce feature dimensions while retaining information.
t-Distributed Stochastic Neighbor Embedding (t-SNE): Visualize high-dimensional data in 2D/3D space.
Experiment 7: Neural Networks Basics
Objective: Gain exposure to neural networks and deep learning.
Feedforward Neural Network: Build a basic neural network using TensorFlow or PyTorch.
Activation Functions: Explore different activation functions and their effects.
Experiment 8: Model Fine-Tuning Objective: Learn techniques to improve model performance.
Hyperparameter Tuning: Use techniques like grid search or random search to optimize hyperparameters.
Learning Curves: Analyze learning curves to diagnose model underfitting or overfitting.
Experiment 9: Model Interpretability
Objective: Explore methods to interpret complex machine learning models.
Feature Importance: Use techniques like permutation importance and SHAP values.
Partial Dependence Plots: Visualize the impact of specific features on model predictions.
Experiment 10: Project Work
Objective: Apply the concepts learned throughout the course to a real-world dataset.
Students select a dataset and a problem of interest.
Preprocess the data, choose appropriate models, and evaluate their performance.
Present findings, insights, and model interpretations.
Remember to adapt these experiments based on your students' skill levels, available resources, and the duration of the lab course. Additionally, provide guidance and assistance to students as they work through these experiments to ensure a meaningful learning experience.

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DSE–1(A) **Information Retrieval Systems**

Theory 4 Hours/Week 4credits

Unit -I

Boolean Retrieval: An example information, Building an inverted index, Processing Boolean queries, The extended Boolean model versus ranked retrieval.
The term vocabulary and postings lists: Document delineation and character sequence decoding, determining the vocabulary of terms, faster postings list intersection via skip pointers, Positional postings, and Phrase queries.
Dictionaries and tolerant retrieval: Search structures for dictionaries, Wildcard queries, Spelling correction.
Index construction: Hardware basics, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing

Unit -II

Index compression: Statistical properties of terms in information retrieval, Dictionary compression, Postings file compression.
Scoring, term weighting and the vector space model: Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring, and Variant tf-idf functions.
Computing scores in a complete search system: Efficient scoring and ranking, Components of an information retrieval system, Vector space scoring and query operator interaction.
Evaluation in information retrieval: Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing relevance.

Unit -III

Relevance feedback and query expansion: Relevance feedback and pseudo relevance feedback, Global methods for query reformulation. Probabilistic information retrieval: Basic probability theory, The Probability Ranking Principle, The Binary Independence Model.
Language models for information retrieval: Language models, The query likelihood model.

Unit -IV

Web search basics: Background and history, Web characteristics, The search user experience, Near-duplicates and shingling.
Web crawling and Indexes: Overview, Crawling,
Link analysis: The Web as a graph, Page Rank, Hubs and Authorities.

Suggested Readings

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, "An Introduction to Information Retrieval", Cambridge University Press, Cambridge, England, 2008.

References:

2. David A. Grossman, Ophir Frieder, "Information Retrieval – Algorithms and Heuristics", Springer, 2nd Edition (Distributed by Universities Press), 2004.
3. Gerald J Kowalski, Mark T Maybury. "Information Storage and Retrieval Systems", Springer,2000.
4. Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", Morgan-Kaufmann Publishers, 2002.

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DSE–1(B) **Image Processing**

Theory 4 Hours/Week 4credits

Unit -I

Fundamentals of Image Processing: Introduction, examples, fundamental steps, components, elements of visual perception, light and electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, basic relationships between pixels.
Intensity Transformations And Spatial Filtering: Background, some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters, sharpening spatial filters, combining spatial enhancement methods.

Unit -II

Filtering In The Frequency Domain: Background, preliminary concepts, sampling and Fourier transform of sampled functions, discrete Fourier transform (DFT) of one variable, extension to functions of two variables, some properties of the 2-D discrete Fourier transform, basics of filtering in the frequency domain, image smoothing, image sharpening, homo- morphic filtering.

Unit -III

Image Restoration: Noise models, restoration in the presence of noise only-spatial filtering, periodic noise reduction by frequency domain filtering, linear degradation, position-invariant degradation, estimating the degradation function, inverse filtering, minimum mean square error filtering, constrained least squares filtering, geometric mean filter.
Image Compression: Fundamentals, image compression models, elements of information theory, error free compression, lossy compression, image compression standards.

Unit -IV

Image Segmentation: Fundamentals, point, line and edge detection, thresholding, regionbased segmentation, segmentation using morphological watersheds, the use of motion in segmèntation.
Morphological Image Processing: Preliminaries, erosion and dilation, opening and closing, the Hit-or-Miss transformation, some basic morphological algorithms, some basic gray-scale morphological algorithms.

Suggested Readings

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, PHI Learning Pvt. Limited, 3rd Edition, 2008.
2. Rafael C.Gonzalez, Richard E.Woods and Steven L.Eddins, Digital Image Processing Using MATLAB, 2nd Edition, McGraw Hill, 2010.
3. AL. Bovik, The Essential Guide to Image processing, 2 nd Edition, Elsevier, 2009.
4. Anil K.Jain, "Fundamentals of Digital Image Processing", PHI, 2006.
5. William K. Pratt, Digital Image Processing, John Wiley & Sons, Inc., 3rd Edition, 2001

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Semester -VI

SEC–4 **SciLab**

Theory	1 Hours/Week	1 credits
Practical	2 Hours/Week	1credit

Unit -I

Installation of the software Scilab - Basic syntax - Mathematical Operators - Predefined constants - Built in functions - Complex numbers, Polynomials, Vectors.

Unit -II

Matrices - Handling these data structures using built in functions.
Programming - Functions - Looping and Branching - Conditional statements - Handling .sci files - Graphics handling - 2D, 3D plots- Generating .jpg files

Suggested Readings

1. Introduction to Scilab, Consortium Scilab
2. Modeling and simulation in Scilab, Springer, Stephen L. Campbell Jean-Philippe Chancelier and RanineNikoukhah
3. Scilab Bag of Tricks , Lydia E.vanDijk, Christoph L. Spiel

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SciLab LAB

Practical 2 Hours/Week 1 credits

Lab: Practicals

1. Using SciLab Creating a matrix and find Transpose of a matrix.
2. Using SciLab find Determinant of matrices.
3. Using SciLab Addition and Product of two matrices
4. Using SciLab find the inverse of the matrix.
5. SciLab programme to solving equation using matrices.
6. SciLab programme to find Eigen values and vectors of a given matrix.
7. Solving linear differential equation using SciLab.
8. Finding the roots of quadratic equations using SciLab.
9. Verify the Roles Theorem using SciLab.
10. Expansion of Maclaurins series using SciLab.
11. Program to test Abelian Group properties for given finite set using SciLab.
12. Program to find all possible Cosets of the given finite Group using SciLab.
13. Program to find all generators and corresponding all possible Subgroups for the given Cyclic Group using SciLab.
14. Programme to verify Lagrange's theorem for given finite Group.

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DSC–21

Design and Analysis of Algorithms

Theory	3 Hours/Week	3credits
Tutorial	1 Hours/Week	1credit

Unit -I

Introduction: Algorithm definition, and Specification, Asymptotic Analysis – Best, Average, and Worst-case behavior; Performance measurements of Algorithms, Time and Space complexities, Analysis of Recursive Algorithms.
Basic Data Structures: Stacks and Queues Disjoint set operations, union and find algorithms, Dictionaries, Graphs, Trees.

Unit -II

Divide and Conquer: General method, Control abstraction, Merge sort, Quick Sort – Worst, Best and average case. Binary search, Strassen's Matrix Multiplication, Convex Hull.
Greedy method: General method, applications- Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees, Single source shortest path problem.

Unit -III

Dynamic Programming: General Method, applications- All pairs shortest path problem, Optimal binary search trees, 0/1 knapsack problem, Reliability design, Traveling sales person problem.
Backtracking: General method, 8-Queen problem, Sum of Subsets, Graph Coloring, Hamiltonian Cycle, 0/1 Knapsack Problem.
Branch and Bound: Control abstractions for Least Cost Search, Bounding, FIFO branch and bound, LC branch and bound, 0/1 Knapsack problem, Traveling sales person problem.

Unit -IV

Basic Traversal and Search Techniques: Techniques for Binary Trees, Techniques for Graphs, Connected Components and Spanning Trees, Graph Traversals- DFS, BFS.
NP Hard and NP Complete Problems: Basic Concepts, Cook's Theorem, NP-Hard Graph Problems, NP-Hard Scheduling Problems, NP-Hard Code Generation, Some Simplified NP-Hard Problems.

Suggested Readings

1. E. Horowitz, S. Sahni,S.Rajasekaran, " Fundamentals of Computer Algorithms", Second Edition, Universities Press, 2007
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

References:

1. M T Goodrich, Roberto Tamassia," Algorithm Design", John Wiley, 2002.
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
3. R. Pannerselvam, "Design and Analysis of Algorithms",PHI,2007.
4. Udit Agarwal, " Algorithm Design & Analysis", Dhanpat Rai,2008.
5. Hari Mohan Pandey, "Design, Analysis and Algorithm", University Science Press, 2009.

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DSC–22

Data Mining Using Python

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit -I

Introduction to Data Mining: Overview of data mining and its applications, Data mining process: data collection, preprocessing, modeling, evaluation, and deployment, Ethical considerations in data mining
Python Basics for Data Mining: Review of Python programming fundamentals (variables, data types, control structures, functions), Introduction to data manipulation libraries: NumPy and Pandas

Unit -II

Data Pre processing: Data cleaning and handling missing values, Data transformation and normalization, Handling categorical data
Exploratory Data Analysis (EDA): Visualizing data using Matplotlib and Seaborn, Descriptive statistics and summary metrics, Identifying patterns and outliers in data.

Unit -III

Data Mining Techniques: Association rule mining, Clustering techniques (K-means, hierarchical clustering), Dimensionality reduction (Principal Component Analysis)
Classification Algorithms: Introduction to supervised learning, Decision trees and random forests, Naive Bayes classifier, Model evaluation metrics (accuracy, precision, recall, F1-score)

Unit -IV

Regression and Time Series Analysis: Linear regression, Time series data analysis, Forecasting techniques.

Suggested Readings

1. McKinney, W. (2017). Python for Data Analysis. O'Reilly Media.
2. Tan, P.-N., Steinbach, M., & Kumar, V. (2005). Introduction to Data Mining. Pearson.

References:

1. Online tutorials, resources, and research papers on specific data mining topics
2. Online platforms like Kaggle for real-world datasets and challenges

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Data Mining Using Python LAB

Practical 2 Hours/Week 1 credits

1. Setting up Python environment (Anaconda, Jupyter Notebook)
2. Programs Using NumPy and Pandas for data manipulation
3. Cleaning and handling missing data using Pandas, Normalization and scaling techniques, One-hot encoding for categorical data
4. Visualizing data using Matplotlib and Seaborn, Calculating summary statistics and distribution analysis, Identifying and handling outliers
5. Implementing Apriori algorithm to find frequent itemsets, Generating association rules from frequent itemsets
6. Interpretation and evaluation of association rules
7. Implementing K-means clustering algorithm, Hierarchical clustering using SciPy, Visualizing clusters and evaluating clustering results
8. Applying Principal Component Analysis (PCA) for feature reduction, Visualizing reduced-dimensional data, Understanding the trade-offs of dimensionality reduction
9. Implementing decision tree and random forest classifiers, Training and evaluating a Naive Bayes classifier, Comparing classification performance metrics
10. Using cross-validation for model evaluation, Hyperparameter tuning for improving model performance, Selecting the best model based on evaluation results
11. Implementing linear regression for predicting numerical values, Analyzing and visualizing time series data
12. Forecasting using basic time series techniques

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DSC–23

Software Engineering

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit -I

The Software Process: Software and Software Engineering, Software Development Process Models – The Waterfall Model, V-Model , Incremental
Process Models: Prototyping, the Spiral Model, Concurrent Models. Software Implementation and Management process- inspection, Agile Development, Principles that Guide Practice

Unit -II

Modeling and Design: Understanding Requirements, Requirements Modeling: Scenarios, Information, and Analysis Classes, Requirements Modeling for WebApps, Design Concepts,
Software Architecture : Definition, Importance and Styles, User Interface Design

Unit -III

Quality Management and Testing: Quality Concepts, Review Techniques, Software Quality Assurance, Software Configuration Management, Product Metrics
Software Testing Strategies: Testing Conventional Applications, Testing Object-Oriented Applications, Testing Web Applications

Unit -IV

Project Management: Project Management Concepts, Process and Project Metrics, Estimation for Software Projects, Project Scheduling, Risk Management

References:

1. R.S. Pressman, Software Engineering: A Practitioner's Approach, MGHISE, 7th Edition, 2010
2. I.Sommerville, Software Engineering, Pearson Education, 7th Ed., 2005.
3. Pankaj Jalote, Software Engineering: A Precise Approach,, Wiley, 2010

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Software Engineering LAB

Practical 2 Hours/Week 1credit

Carryout the following 5 exercises for any two projects given in the list of sample projects or any other project:

1. Development of problem statement.
2. Prepare a Software Requirement Specification Document for the chosen problem
3. Prepare Design Specification and produce a Detail Design Document
4. Develop test cases for unit testing and integration testing
5. Develop test cases for various white box and black box testing techniques.

Sample Projects:

1. Learning Management System
2. Online Exam Registration
3. Online reservation for bus service
4. E-book management system
5. Inventory management for a retail store
6. Online store
7. Student Management System for a college
8. Online food service
9. Online Movie ticket booking
10. Recruitment system

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DSC–24

Deep Learning

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit -I

Introduction: History, Hardware, Data, Algorithms, Neural Networks, Data representations for neural networks, Scalars (0D tensors), Vectors (1D tensors), Matrices (2D tensors), 3D tensors and higher-dimensional tensors, Key attributes, Manipulating tensors in Numpy, The notion of data batches, Real-world examples of data tensors, Vector data, Time series data or sequence data, Image data, Video data

Unit -II

Tensor operations: Element-wise operations, Broadcasting, Tensor dot,. Tensor reshaping, Geometric interpretation of tensor operations, A geometric interpretation of deep learning,

Unit -III

Gradient-based optimization, Derivative of a tensor operation, Stochastic gradient descent,. Chaining derivatives: the Backpropagation algorithm
Neural networks: Anatomy, Layers, Models, Loss functions and optimizers

Unit -IV

Introduction to Keras: Keras, TensorFlow, Theano, and CNTK
Recurrent neural networks: A recurrent layer in Keras, Understanding the LSTM and GRU Layers

References:

1. François Chollet. Deep Learning with Python. Manning Publications, 2018
   Suggested Reading:
2. AurélienGéron. Hands on Machine Learning with SciKit-Learn, Keras and Tensor Flow. O'Reily, 2019
3. Andrew W. Trask. Grokking Deep Learning. Manning Publications, 2019

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Deep Learning LAB

Practical 2 Hours/Week 1credit

Objectives: The main objective of this lab is to develop deep learning models using Keras

Deep Learning Tools

Students are expected to learn Keras deep-learning framework (https://keras.io), which is open source and free to download. They should have access to a UNIX machine; though it's possible to use Windows, too. It is also recommended that they work on a recent NVIDIA GPU

Exercises:

Note: The exercises should following Keras workflow consisting of four steps

1. Define your training data: input tensors and target tensors
2. Define a network of layers (or model) that maps your inputs to your targets
3. Configure the learning process by choosing a loss function, an optimizer, and some metrics to monitor
4. Iterate on your training data by calling the fit() method of your model

Exercise 1:

Dataset:

IMDB dataset, a set of 50,000 highly polarized reviews from the Internet Movie Database. They're split into 25,000 reviews for training and 25,000 reviews for testing, each set consisting of 50% negative and 50% positive reviews. the IMDB dataset comes packaged with Keras

Binary Classification Task:

Build a network to classify movie reviews as positive or negative, based on the text content of the reviews.

Exercise 2:

Dataset:

Reuters dataset, a set of short newswires and their topics, published by Reuters in 1986. It's a simple, widely used toy dataset for text classification. There are 46 different topics; some topics are more represented than others, but each topic has at least 10 examples in the training set. Reuters dataset comes packaged as part of Keras.

Single-label Multi class Classification Task:

Build a network to classify Reuters newswires into 46 mutually exclusive topics. Each data point should be classified into only one category (in this case, topic),. The problem is more specifically an instance of single-label, multiclass classification.

Exercise 3:

Dataset:

The Boston Housing Price dataset has an interesting difference from the two previous examples. It has relatively few data points: only 506, split between 404 training samples and 102 test samples. And each feature in the input data (for example, the crime rate) has a different scale. For instance, some values are proportions, which take values between 0 and 1; others take values between 1 and 12, others between 0 and 100, and so on.

Regression Task:

The two previous examples were classification problems, where the goal was to predict a single discrete label of an input data point. Another common type of machine-learning problem is regression, which consists of predicting a continuous value instead of a discrete label. You'll attempt to predict the median price of homes in a given Boston suburb in the mid-1970s, given data points about the suburb at the time, such as the crime rate, the local property tax rate, and so on.

3. More exercises can be defined on similar lines.

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DSE–2(A)

Big Data

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit -I

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, 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: Introducing Hadoop, HDFS and MapReduce, Hadoop functions, 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.

Unit -III

Understanding MapReduce Fundamentals and HBase: The MapReduceFramework ,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.

Unit -IV

Storing Data in Databases and Data Warehouses: RDBMS and Big Data, Issues with Relational Model, Non – Relational Database, Issues with Non Relational Database, Polyglot Persistence, Integrating Big Data with Traditional Data Warehouse, Big Data Analysis and Data Warehouse.
NoSQL Data Management: Introduction to 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, CAP Theorem.

Suggested Readings

1. BIG DATA, Black Book TM, DreamTech Press, 2016 Edition.
2. Seema Acharya, Subhasni Chellappan , "BIG DATA and ANALYTICS", Wiley publications, 2016
3. Nathan Marz and James Warren, "BIG DATA- Principles and Best Practices of Scalable Real-Time Systems", 2010

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Big Data LAB

Practical 2 Hours/Week 1credit

Objectives:

- Installation and understanding of working of HADOOP
- Understanding of MapReduce program paradigm.
- Writing programs in Python using MapReduce
- Understanding working of Pig, Hive
- Understanding of working of Apache Spark Cluster

1. Setting up and Installing Hadoop in its two operating modes:
   - Pseudo distributed,
   - Fully distributed.
2. Implementation of the following file management tasks in Hadoop:
   - Adding files and directories
   - Retrieving files
   - Deleting files
3. Implementation of Word Count Map Reduce program
   - Find the number of occurrence of each word appearing in the input file(s)
   - Performing a MapReduce Job for word search count (look for specific keywords in a file)
4. Map Reduce Program for Stop word elimination:
   - Map Reduce program to eliminate stop words from a large text file.
5. Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented. Data available at: https://github.com/tomwhite/hadoop- book/tree/master/input/ncdc/all.
   - Find average, max and min temperature for each year in NCDC data set?
   - Filter the readings of a set based on value of the measurement, Output the line of input files associated with a temperature value greater than 30.0 and store it in a separate file.
6. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.
7. Write a Pig Latin script for finding TF-IDF value for book dataset (A corpus of eBooks available at: Project Gutenberg)
8. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.
9. Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scala. Perform Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together

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DSE–2(B)

Natural Language Processing

Theory	3 Hours/Week	3credits
Practical	2 Hours/Week	1credit

Unit -I

Language Processing and Python: Computing with Language: Texts and Words, A Closer Look at Python: Texts as Lists of Words, Computing with Language: Simple Statistics, Back to Python: Making Decisions and Taking Control, Automatic Natural Language Understanding
Accessing Text Corpora and Lexical Resources: Accessing Text Corpora, Conditional Frequency Distributions, Lexical Resources, WordNet

Unit -II

Processing Raw Text: Accessing Text from the Web and from Disk, Strings: Text Processing at the Lowest Level, Text Processing with Unicode, Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text, Regular Expressions for Tokenizing Text, Segmentation, Formatting: From Lists to Strings.
Categorizing and Tagging Words: Using a Tagger, Tagged Corpora, Mapping Words to Properties Using Python Dictionaries, Automatic Tagging, N-Gram Tagging, Transformation-Based Tagging, How to Determine the Category of a Word

Unit -III

Learning to Classify Text: Supervised Classification, Evaluation, Naive Bayes Classifiers
Deep Learning for NLP: Introduction to Deep Learning, Convolutional Neural Networks, Recurrent Neural Networks, Classifying Text with Deep Learning

Unit -IV

Extracting Information from Text : Information Extraction, Chunking, Developing and Evaluating Chunkers, Recursion in Linguistic Structure, Named Entity Recognition, Relation Extraction.
Analyzing Sentence Structure : Some Grammatical Dilemmas, What's the Use of Syntax. Context-Free Grammar, Parsing with Context-Free Grammar.

Suggested Readings

1. Natural Language Processing with Python. Steven Bird, Ewan Klein, and Edward Lope, O'Reily, 2009
2. Natural Language Processing Recipes: Unlocking Text Data with Machine Learning a Deep Learning using Python. Akshay Kulkarni, AdarshaShivananda, Apress, 2019

References:

3. Allen James, Natural Language Understanding, Benjamin/Cumming,1995.
4. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.

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Natural Language Processing LAB

Practical 2 Hours/Week 1credit

Objective: The main objective of this laboratory is to write programs that manipulate and analyze language data using Python

This lab requires mentoring sessions from TCS.

Python Packages

Students are expected to know/ learn the following Python NLP packages

- NLTK (www.nltk.org/ (http://www.nltk.org/))
- Spacy (https://spacy.io/)
- TextBlob (http://textblob.readthedocs.io/en/dev/
- Gensim (https://pypi.python.org/pypi/gensim)
- Pattern (https://pypi.python.org/pypi/Pattern)

Datasets:

1. NLTK includes a small selection of texts from the Project Gutenberg electronic text archive, which contains some 25,000 free electronic books, hosted at http://www.gutenberg.org/.
2. The Brown Corpus contains text from 500 sources, and the sources have been categorized by genre, such as news, editorial, and so on (http://icame.uib.no/brown/bcmlos.html).
3. Wikipedia Articles

Or any other dataset of your choice

Reference:

Jacob Perkins. Python 3 Text Processing with NLTK 3 Cookbook. Packt Publishing. 2014

Exercises:

1. Text segmentation: Segment a text into linguistically meaningful units, such as paragraphs, sentences, or words. Write programs to segment text (in different formats) into tokens (words and word-like units) using regular expressions. Compare an automatic tokenization with a gold standard
2. Part-of-speech tagging: Label words (tokens) with parts of speech such as noun, adjective, and verb using a variety of tagging methods , e.g., default tagger, regular expression tagger, unigram tagger, and n-gram taggers.
3. Text classification: Categorize text documents into predefined classes using Naïve Bayes Classifier and the Perceptron model
4. Chunk extraction, or partial parsing: Extract short phrases from a part-of-speech tagged sentence. This is different from full parsing in that we're interested in standalone chunks, or phrases, instead of full parse trees
5. Parsing: parsing specific kinds of data, focusing primarily on dates, times, and HTML. Make use of the following preprocessing libraries:
   - dateutil which provides datetime parsing and timezone conversion
   - lxml and BeautifulSoup which can parse, clean, and convert HTML
   - charade and UnicodeDammit which can detect and convert text character encoding
6. Sentiment Analysis: Using Libraries TextBlob and nltk, give the sentiment of a document

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Project

Theory 6 Hours/Week 3 credits

Course Objectives:

- To provide hands-on experience in analysis, design, and programming of information systems by means of case studies and projects.
- To expose the students to industry practices and team work.
- To enhance the skills in presenting seminars and technical report writing.

Solving a real life problem should be the focus of 3rd year project. Faculty members should propose the project briefs (scope and references) well in advance which should be made available to the project coordinator. The project should normally involve activities such as literature survey, analysis, design, and implementation. Problems can also be invited from the industries.

The department will appoint a project coordinator who will coordinate the following:

- Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)
- Grouping of students (max 3 in a group)
- Allotment of project and project guides to the student groups
- Conducting seminar presentation
- Coordinating viva-voce exam

Project allotment is to be completed by the 2nd week of VI semester so that students get sufficient time for completion of the project.

Projects shall be monitored twice in a semester through presentations. Sessional marks are to be based on the marks/grades, awarded by a monitoring committee comprising of faculty members as well as by the guide.

Department will establish common norms for the project documentation.
At the end of semester, an external examiner in coordination with project coordinator will conduct a viva-voce exam for 100 marks.

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Semester -VII

DSCH–1 **Research Methodology**

Theory 3 Hours/Week 3 credits

Unit -I

Research — Meaning — Significance — Objectives — Types of Research — Research Methods vs. Methodology — Steps in Research - Research and Scientific Method - Importance of Knowing How Research is Done - Research Process - Criteria of Good Research. Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.

Unit -II

Defining the Research Problem : Research Problem — Definition — Nature — Formulation — Scientific Thinking - Techniques of Defining the Problem — Research Design — Meaning — Needs — Types of Research Design — Variables — Dependent and Independent Variables — Extraneous Variables — Intervening Variable — Dichotomous Variable — Research Proposal and its Preparation — Research Hypothesis — Types of Hypotheses.

Unit -III

Experimental method - Types of Experimental Research - Characteristics of Experimental Research - Elements - Experimental validity
Sampling Techniques: Types of sampling: random, stratified, systematic, convenience, snowball. Sample size determination, Sampling errors and biases
Data Analysis: Descriptive statistics: measures of central tendency and variability, Inferential statistics: hypothesis testing, t-tests, ANOVA, chi-square, correlation, regression, Qualitative data analysis: thematic analysis, content analysis.

Unit -IV

Research Ethics and Plagiarism: Ethical considerations in research: informed consent, confidentiality, conflicts of interest, Avoiding plagiarism and maintaining academic integrity
Research Proposal and Report Writing: Components of a research proposal, Steps in writing a research report, Citations and referencing styles.
IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS).

References:

1. Research Methodology, C.R. Kothari, WishwaPrakasan.
2. Research Methodology, R. Paneerselvam, Prentice-Hall of India.
3. Research Methodology, O.R. Krishna Swami, M.Ranganathan, P.N.Harikumar, Himalaya Publishing House Pvt. Ltd.
4. Research Methodology: Tools and Techniques, Dr. Prabhat Pandey , Dr. Meenu Mishra Pandey.
5. History of the Scientific Methods: by Martin Shuttleworth, https://explorable.com/history-of-thescientific-method

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DSCH–2 **Cloud Computing**

Theory 3 Hours/Week 3 credits

Unit -I

Introduction, Benefits and challenges, Cloud computing services, Resource Virtualization, Resource pooling sharing and provisioning
Scaling in the Cloud, Capacity Planning , Load Balancing, File System and Storage,

Unit -II

Multi-tenant Software, Data in Cloud , Database Technology, Content Delivery Network, Security Reference Model , Security Issues, Privacy and Compliance Issues

Unit -III

Portability and Interoperability Issues, Cloud Management and a Programming Model Case Study, Popular Cloud Services

Unit -IV

Enterprise architecture and SOA, Enterprise Software , Enterprise Custom Applications, Workflow and Business Processes, Enterprise Analytics and Search, Enterprise Cloud Computing Ecosystem.

Suggested Readings

1. Sandeep Bhowmik , Cloud Computing, Cambridge University Press, 2017.
2. Gautam Shroff, Enterprise Cloud Computing - Technology, Architecture, Applications by, Cambridge University Press, 2016.
3. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, Distributed and Cloud Computing From Parallel Processing to the Internet of Things, Elsevier, 2012.

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DSCH–3 **Computer Networks**

Theory 3 Hours/Week 3 credits

Unit -I

Data Communications: Components - Direction of Data flow - networks -Components and Categories - types of Connections - Topologies -Protocols and Standards - ISO/OSI model - Layered Architecture, Functions of Layers, TCP/IP Reference Model.
Transmission Media: Guided Media-Twisted Pair Cable Coaxial Cable, Optical Fiber, Unguided Media-Satellite Communication, and Cellular Telephony.

Unit -II

Data link Layer : Error detection and correction, CRC, Hamming code, Flow Control and Error control - stop and wait - go back-N ARQ - selective repeat ARQ-sliding window - HDLC.
Introduction to Ethernet: IEEE 802.3 -IEEE 802.4 -IEEE 802.5, Bridges.

Unit -III

Network Layer : Networking and Internetworking Devices: Repeaters, Bridges, Routers, Gateways, Brouters, Switches, virtual circuit and Datagram approach, Routers IP addressing, Subnetting, CIDR.
Routing - Distance Vector Routing, Link State Routing.

Unit -IV

Transport Layer : Services of transport layer, Multiplexing. Transmission Control Protocol (TCP) and User Datagram Protocol (UDP)
Application Layer: Domain Name Space (DNS) - SMTP - FTP - HTTP - WWW.

Suggested Readings

1. Andrew S. Tanenbaum, "Computer Networks", Pearson Education; Fourth Edition, 2011.
2. Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw-Hill, 2009.

References:

1. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Pearson Education, 2006.

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DSEH–1(A) **Cryptography**

Theory 3 Hours/Week 3 credits

Unit -I

Basic Concepts in Number Theory: Divisibility and Division Algorithm - Euclidean Algorithm - Modular Arithmetic and Properties - The extended Euclidean Algorithm.

Unit -II

Classical Encryption Techniques: Symmetric Cipher Model: Cryptography - Cryptanalysis and Brute - Force Attack Substitution Techniques: Caesar Cipher - Monoalphabetic Ciphers - Playfair Cipher - Hill Cipher - Polyalphabetic Ciphers - Transposition Technique.

Unit -III

Methods for Testing of Primality and Discrete logarithms: Prime Numbers - Fermats and Eulers Theorems - Testing for Primality , The Chinese Remainder Theorem - Discrete Logarithms.

Unit -IV

Public-Key Cryptography - RSA and other Algorithms: Principles of Public-Key Cryptosystems: Public-Key Cryptosystems - Applications for Public-Key Cryptosystems - Requirements for Public-Key Cryptography - Public-Key Cryptanalysis.
The RSA Algorithm:- Description of the Algorithm - Computational Aspects - The Security of RSA. Diffie-Hellman Key Exchange - The Algorithm - ElGamal Cryptographic System.

Suggested Readings

1. William Stallings, "Cryptography and Network Security Principles and Practice", Pearson 8th Edition

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DSEH–1(B) **Enterprise Systems**

Theory 3 Hours/Week 3 credits

Unit -I

Introduction to Enterprise Systems: Definition and significance of enterprise systems, Historical evolution of enterprise systems, Types of enterprise systems: ERP, CRM, SCM, BI. Role of enterprise systems in organizational efficiency and competitiveness.
Enterprise System Components: Hardware, software, and network infrastructure, Databases and data management in enterprise systems, User interfaces and user experience (UI/UX) design, Integration and interoperability of system components.

Unit -II

Enterprise System Implementation: System selection and vendor evaluation, Project management methodologies for implementation, Change management and overcoming resistance, Risk assessment and mitigation in implementation projects
Business Processes and Enterprise Systems: Understanding core business processes, Business process reengineering vs. customization, Mapping business processes to system workflows, Process optimization through enterprise systems

Unit -III

Data and Decision-Making: Data collection, storage, and analysis, Business intelligence and reporting tools, Data-driven decision-making and its impact on organizational strategy, Data security and privacy considerations
Enterprise System Challenges and Trends: Common challenges in enterprise system implementation and usage, Cloud-based enterprise systems, Mobile and remote access to enterprise systems, AI and automation in enterprise systems

Unit -IV

Case Studies and Student Presentations:
Healthcare Information Systems: Overview of Healthcare Industry, Key Stakeholders in Healthcare Industry, Health Information Technology (HIT), Health Information Exchange (HIE), Data Standards in Healthcare Industry &; Medical Coding – HL7, HIPAA, DICOM, Electronic Health Records (EHR),Medical Imaging, Data Privacy in Health Information Systems. Data Processing in Healthcare Industry, Clinical Data Warehouse, Data Mining in Healthcare, Healthcare Data Analytics.
Retail Management: Overview, CRM, Supply Chain Management, Merchandise Display, Automatic Identification and Data Capture (AIDC), POS – Electronic Point of sale, Hardware, Software, Payment Methods, 6) Electronic Data Interchange (EDI) in Retail, Emerging Retail Technologies, Ecommerce and E-tailing, Mobile Computing and M-Commerce, GPS, RFID.

References:

1. Motiwalla, L., & Thompson, J. (2012). Enterprise systems for management. Pearson.
2. Garg, V. K., &Venkitakrishnan, N. K. (2016). Enterprise resource planning: Concepts and practice. PHI Learning.
3. Practical Guide for Healthcare and Information Technology Professional
4. https://paramedical.zbmu.ac.ir/file/download/page/1578390340-health-informatics-6th-edition.pdf

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Skill Lab

Selenium: Automated Testing for Web Applications

Practical 2 Hours/Week 1 credits

Experiments covering the topics below need to be carried out.

1. Introduction to Automated Testing
   - Importance of automated testing
   - Advantages and challenges of automated testing
2. Introduction to Selenium
   - Overview of Selenium framework
   - Selenium components: WebDriver, IDE, Grid
3. Setting Up the Testing Environment
   - Installing necessary tools and libraries
   - Configuring Selenium WebDriver
4. Locators and Interactions
   - Identifying web elements using various locators
   - Performing interactions (clicks, inputs, selections)
5. Writing Test Scripts with Selenium
   - Basic structure of a Selenium test script
   - Handling synchronization issues
   - Managing browser sessions
6. Test Automation Frameworks
   - Introduction to test automation frameworks
   - Creating modular and data-driven test scripts
7. Advanced Selenium Techniques
   - Handling pop-ups and alerts
   - Working with iframes and multiple windows
   - Handling dynamic web content
8. Test Reporting and Continuous Integration
   - Generating test reports
   - Integrating Selenium tests with CI/CD pipelines
9. Best Practices for Test Automation
   - Designing maintainable test scripts
   - Test data management
   - Error handling and debugging
10. Real-world Application of Selenium
    - Testing web forms and user interfaces
    - Cross-browser and cross-platform testing

References:

1. Selenium WebDriver Practical Guide by Satya Avasarala
2. Mastering Selenium WebDriver by Mark Collin

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Project Work/ Industry Internship Phase-1

Theory 2 Hours/Week 2 credits

Course Objectives:

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:

Student will be able to:

- Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
- Evaluate different solutions based on economic and technical feasibility
- Effectively plan a project and confidently perform all aspects of project management
- Demonstrate effective written and oral communication skills

The department will appoint a project coordinator who will coordinate the following:

- Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries)
- Grouping of students (max 3 in a group)
- Allotment of projects and project guides to students
- Conducting seminar presentation
- Coordinating viva-voce exam

The above tasks should be completed within the first two weeks of VII semester.

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. To get awareness on current problems and solution techniques, Project coordinator shall arrange special lectures during the first 2 weeks of VII semester by inviting faculty members, professionals from industries and R&D institutions. Further, these lectures may be conducted anytime during the semester to enable the students to gather information on problems and industry practices. At the end of 2nd week, each group with the help of guide shall formalise the project proposal with problem definition, scope, literature survey, probable solution etc. The coordinator shall prepare seminar schedule for all the students(batch wise) from the 5th week to the last week of the semester which should be strictly adhered to.

The coordinator will prepare seminar schedule for all the students from the 5th week to the last week of the semester, which should be strictly adhered to.

Each group will be required to:

- Submit a one page synopsis before the seminar for display on notice board.
- Give a 30 minutes presentation followed by 10 minutes discussion.
- Submit a technical write-up on the talk.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks, which will be based on performance in all the 3 items stated above.

The seminar presentation should include the following components of the project:

- Problem definition and specification
- Literature survey
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar (activity) charts
- Presentation- oral and written.

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Semester-VIII
Project Work/ Industry Internship Phase-II

Theory 12 Hours/Week 12 credits

Course Objectives:

- To enhance practical and professional skills.
- To familiarize tools and techniques of systematic Literature survey and documentation
- To expose the students to industry practices and team work.
- To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:

Student will able to:

- Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the academic program to real-world problems
- Evaluate different solutions based on economic and technical feasibility
- Effectively plan a project and confidently perform all aspects of project management
- Demonstrate effective written and oral communication skills

The aim of project work–II is to implement and evaluate the proposal made as part of phase-1. Students can also be encouraged to do full time internship as part of project work. The students placed in internships need to write the new proposal in consultation with industry coordinator and project guide within two weeks from the commencement of instruction.

Coordinator appointed during the VII semester continue to coordinate the students, guides and industry coordinators.

All projects (internship and departmental) will be monitored twice in the semester through student presentation for the award of sessional marks. A monitoring committee comprising of faculty members and the guide awards sessional marks. The first review of projects for 25 marks shall be conducted after completion of five weeks. The second review for another 25 marks shall be conducted after 12 weeks of instruction.

The students are required to submit draft copies of their project report within one week after completion of instruction.
Department will establish common norms for the project documentation.

At the end of semester, an external examiner in coordination with project coordinator will conduct a viva-voce exam for 100 marks.

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