SAVITRIBAI PHULE PUNE UNIVERSITY

PUNE

CHOICE BASED CREDIT SYSTEM

for

B.Sc.(Cyber and Digital Science)

(Implemented from June 2020)

Savitribai Phule Pune University

B. Sc.(Cyber and Digital Science)

(To be implemented from Academic year 2020-2021)

1. **Name of Program:** Cyber and Digital Science

2. **No. of students per division:**

3. **Introduction:**

Digital and Cyber Forensics is a niche subject of modern studies which shall prepare students for professional work in business and industry, as well as government and law enforcement. Since Cybercrime has been on the rise in recent years, this course offers a special impetus and an excellent launch pad for those who are interested in becoming professionals' crime-fighters with rewarding career options.

Digital infrastructures and information networks have become crucial in any business activity. The information residing on these computers, networks, and in the cloud is a critical asset and should be secured. The impact of data loss or any downtime of the infrastructure is quite high. Hence, there is a need for heightened security measures to protect both infrastructure and data. The student shall learn the techniques to collect, preserve, analyze, and report digital evidence. It also opens a new avenue for research opportunities into forensics and security issues.

In the information era, digital technologies have opened up immense possibilities for economic and social change that is inclusive and sustainable. Designing and deploying digital technologies, analyzing human-computer interaction or big data will produce technological expertise as well as a nuanced understanding of the social, cultural, and economic aspects of the digital society. Students will gain insights into the design of digital technologies, and the policy challenges of deploying such technologies, with a broad-based training that will draw from computer science, engineering, research methods, management, economics and other social sciences, which will equip them with a rigorous

understanding of technologies for development and the development of technologies.

The Program is of Three Years duration with six semesters. It is a Full-Time Degree Program. The program will be based on the Choice-based credit system comprising 140 credit points.

4. Objectives:

- To strengthen the basics of the subject useful in selecting various career options.
- To make students aware of cybercrime and learn ways to handle them.
- To produce entrepreneurs who can work in the area of Cyber and Digital Forensics.

5. Eligibility:

- Higher secondary school certificate (10+2) or its equivalent examination with English

OR

- Three-year diploma course from the board of technical education conducted by Government of Maharashtra or its equivalent

OR

- Higher secondary school certificate (10+2) Examination with English and a vocational subject of +2 level(MCVC)

Proposed Structure of Cyber and Digital Science

SEMESTER I

Course Type	Paper Code	Paper Title	Credits		Evaluation		
			T	P	CA	UA	Total
CC-I	CDS-111	Introduction to Computers and Problem Solving	4		30	70	100
	CDS-115	Lab on CDS-111		1.5	15	35	50
CC-II	CDS-112	Python Programming	4		30	70	100
	CDS-116	Lab on CDS-112		1.5	15	35	50
CC-III	CDS-113	Basic Mathematical Techniques	4		30	70	100
	CDS-117	Lab on CDS-113		1.5	15	35	50
CC-IV	CDS-114	Basic Statistical Techniques for Computer Science	4		30	70	100
	CDS-118	Lab on CDS-114		1.5	15	35	50

SEMESTER II

Course Type	Paper Code	Paper Title	Credits		Evaluation		
			T	P	CA	UA	Total
CC-V	CDS-121	Fundamentals of Cyber Security	4		30	70	100
	CDS-125	Lab on CDS-121		1.5	15	35	50
CC-VI	CDS-122	Fundamentals of Digital Communication Systems	4		30	70	100
	CDS-126	Lab on CDS-122		1.5	15	35	50
CC-VII	CDS-123	Computer Networks	4		30	70	100
	CDS-127	Lab on CDS-123		1.5	15	35	50
CC-VIII	CDS-124	Programming in C	4		30	70	100
	CDS-128	Lab on CDS-124		1.5	15	35	50

SEMESTER III

Course Type	Paper Code	Paper Title	Credits		Evaluation		
			T	P	CA	UA	Total
CC-IX	CDS-231	Basics of Ethical Hacking	4		30	70	100
	CDS-234	Lab on Web Desigining Tool		2	15	35	50
CC-X	CDS-232	Database Management Sytems	4		30	70	100
	CDS-235	Lab on CDS-232		2	15	35	50
CC-XI	CDS-233	Data Structure Using C	4		30	70	100
	CDS-236	Lab on CDS-233		2	15	35	50
AECC-I	CDS-237	Language- English/Marathi	2		15	35	50
AECC-II	CDS-238	Environment Science-1	2		15	35	50

SEMESTER IV

Course Type	Paper Code	Paper Title	Credits		Evaluation		
			T	P	CA	UA	Total
CC-X	CDS-241	Principles of Operating Systems	4		30	70	100
	CDS-244	Lab on CDS-241		2	15	35	50
CC-XI	CDS-242	Web and Mobile Application	4		30	70	100
	CDS-245	Lab on CDS-242		2	15	35	50
CC-XII	CDS-243	Network Security and Cryptography	4		30	70	100
	CDS-246	Lab on CDS-243		2	15	35	50
AECC-III	CDS-247	Language- English/Marathi	2		15	35	50
AECC-IV	CDS-248	Environment Science-2	2		15	35	50

SEMESTER V

Course Type	Paper Code	Paper Title	Credits		Evaluation		
			T	P	CA	UA	Total
DSEC-I	CDS-351	Digital Forensics-1	4		30	70	100
	CDS-354	Lab on CDS-351		2	15	35	50
DSEC-II	CDS-352	Cyber Threat Intelligence	4		30	70	100
	CDS-355	Lab on CDS-352		2	15	35	50
DSEC-III	CDS-353	Information Security policy and Audit	4		30	70	100
	CDS-356	Lab on CDS-353		2	15	35	50
SECC-I	CDS-357	Professional Elective-I	2		15	35	50
SECC-II	CDS-358	Professional Elective-II		2	15	35	50

SEMESTER VI

Course Type	Paper Code	Paper Title	Credits		Evaluation		
			T	P	CA	UA	Total
DSEC-I	CDS-361	Digital Forensics-2	4		30	70	100
	CDS-364	Lab on CDS-361		2	15	35	50
DSEC-II	CDS-362	Cyber Law (Information Security Policies and Strategies)	4		30	70	100
	CDS-365	Lab on CDS-362		2	15	35	50
DSEC-III	CDS-363	Web Science	4		30	70	100
	CDS-366	Lab on CDS-363		2	15	35	50
SECC-III	CDS-367	Professional Elective-III	2		15	35	50
SECC-IV	CDS-368	Professional Elective-IV		2	15	35	50

*CC: Core Course
*DSE: Discipline Specific Elective
*AECC: Ability Enhancement Compulsory Course
*SECC: Skill Enhancement Compulsory Course

Professional Electives:

SECC (Any one for CDS-357 and CDS-367)	SECC (Any one for CDS-358 and CDS-368)
• Cloud Security	• Lab course on Cloud Security
• Mobile Application and Services	• Lab course on Mobile Application and Services
• Mobile Forensics	• Lab course on Mobile Forensics
• Big Data Analytics	• Lab course on Big Data Analytics
• Block Chain Technology	• Lab course on Block Chain Technology
• Web Services	• Lab course on Web Services
• E-Business	• Lab course on E-Business
• Healthcare Industry – Cybersecurity	• Lab Course on Cybersecurity in Healthcare
• FinTech – Cybersecurity	• Lab course on Cybersecurity in Fin Tech
• DevSecOps	• Lab course on DevSecOps
• Web API Security	• Lab course on Web API Security
• Malware Analysis	• Lab course on Malware Analysis

** Note: There is a one to one mapping from the sets of SECC. A student will have to select a course for CDS-357 and its appropriate mapping for CDS-358.

CDS-111: Introduction to Computers and Problem Solving		
Teaching Scheme 5 Lectures / week	No. of Credits: 4	Examination Scheme CA :30 marks UA: 70 marks

Course Objectives: -

1) To Know the Basics of Computers.
2) To Understand the Basics of Operating systems
3) To Understand how to solve problems using Algorithms and Flowcharts.

Course Outcomes: - Student will be able to: -

1. Learn the fundamental concepts of computer science.
2. Develop the logic of problem solving.

Course Contents

Unit 1	**Introduction to Computers** 1.1 Introduction 1.2 Characteristics of Computers 1.3 Block diagram of computer 1.4 Types of computers and features 1.4.1 Mini Computers 1.4.2 Micro Computers 1.4.3 Mainframe Computers 1.4.4 Super Computers 1.5 Types of Programming Languages 1.5.1 Machine Languages 1.5.2 Assembly Languages 1.5.3 High Level Languages 1.6 Data Organization 1.6.1 Drives 1.6.2 Files 1.6.3 Directories 1.7 Number Systems 1.7.1 Introduction to Binary, Octal, Hexadecimal system 1.7.2 Conversion 1.7.3 Simple Addition, Subtraction, Multiplication, Division	**15 Lectures**
Unit 2	**Computer Devices** 2.1 CPU 2.2 Types of Memory (Primary and Secondary) 2.3 RAM 2.4 ROM 2.5 PROM 2.6 EPROM 2.7 Secondary Storage Devices (CD, HD, Pen drive) 2.8 I/O Devices 2.8.1 Scanners 2.8.2 Digitizers 2.8.3 Plotters 2.8.4 LCD 2.8.5 Plasma Display 2.9 Network Devices 2.9.1Hub 2.9.2 Switch 2.9.3 Router 2.9.4 Bridge 2.9.5 Gateway 2.9.6 Modem	**10 Lectures**

	2.9.7 Repeater 2.9.8 Access Point	
Unit 3	**Operating System and its Services** 3.1 Dos - History 3.2 Files and Directories 3.3 Internal and External Commands 3.4 Batch Files 3.5 Types of O.S.	**8 Lectures**
Unit 4	**Internet Network** 4.1 Network definition 4.2 Common terminologies: LAN, WAN, Node, Host, Workstation, bandwidth, Interoperability, Network administrator, network security 4.3 Network Components: Severs, Clients, Communication Media 4.4 Types of network: Peer to Peer, Clients Server 4.5 Addressing in Internet: DNS, Domain Name and their organization, understanding the Internet Protocol Address. 4.6 Network topologies: Bust, star and ring, Ethernet, FDDI, ATM and Intranet 4.7 Introduction to electronic commerce	**12 Lectures**
Unit 5	**Introduction to Problem Solving** 5.1 Concept: problem solving 5.2 Problem solving techniques (Trial & Error, Brain storming, Divide & Conquer) 5.3 Steps in problem solving (Define Problem, Analyse Problem, Explore Solution) 5.4 Algorithms and Flowcharts (Definitions, Symbols) 5.5 Characteristics of an algorithm 5.6 Conditionals in pseudo-code 5.7 Loops in pseudo code 5.8 Time complexity: Big-Oh notation, efficiency 5.9 Simple Examples: Algorithms and flowcharts (Real Life Examples) 5.10 Simple Arithmetic Problems	**15 Lectures**

Reference Books:

1. Fundamental of Computers – By V. Rajaraman B.P.B. Publications
2. Fundamental of Computers – By P. K. Sinha
3. Computer Today- By Suresh Basandra
4. Unix Concepts and Application – By Sumitabha Das
5. Computer Networks – By Tennenbum Tata MacGrow Hill Publication
6 How to solve it by Computer – R. G. Dromy
7. Introduction to algorithms – Cormen, Leiserson, Rivest, Stein

CDS-115: Lab Course on Introduction to Computers and Problem Solving

List of Sample practical's:

Fundamentals of Computers

1. Write down the steps of installing Windows Operating System.
2. Write down the steps of installing Linux Operating System.
3. Write down the steps of creating a new file in Windows Operating System.
4. Write down the steps of creating a new file in Linux Operating System.
5. Write down the steps for User Account and Group Management in Linux Operating System.
6. Write down the steps for User Account and Group Management in Windows Operating System.
7. Write down the steps to Hide the file and unhide the file in Windows Operating System.
8. File and folder management in Linux.
9. File and folder management in Windows.
10. Working with any five commands in command prompt (DOS).

Networking

1. Study about any five physical equipment used for networking.
2. Study of different internetworking devices in a computer network.
3. Explain about any five working of basic Networking Commands.
4. Study of basic network management commands.
5. Write the steps to Assigning IP address to the PC and Connect to the computer.
6. Write the steps to connect the computer in Local Area Network.
7. Write the steps How to connect a network printer in Windows.
8. Write the steps How to setting to Local Area Network proxy Server.

CDS-112: Python Programming

Teaching Scheme	No. of Credits: 4	Examination Scheme
5 Lectures / week		CA: 30 marks UA: 70 marks

Prerequisites:

1. Minimal knowledge of software installation.

Course Objectives: -

1. This course is designed to give an overall exposure to the students about the computer programming and to develop the logical thinking.
2. All the students should learn to write basic programs which will be helpful for them in their future research.

Course Outcomes: - Student will be able to: -

1. Use python programming elements to solve and debug simple logical problems.
2. Experiment with the various control statements in Python.
3. Develop Python programs using functions and strings.
4. Develop python programs to implement various file operations and exception handling.

Course Contents

Unit 1	Basics of Python Programming	5 Lectures

1.1 Features of Python
1.2 How to Run Python
1.3 Identifiers
1.4 Reserved Keywords
1.5 Variables
1.6 Comments in Python
1.7 Indentation in Python
1.8 Multiline Statements
1.9 Input, Output and Import Functions (Displaying the output, Reading the input, import function)
1.10 Operators (Arithmetic, Comparison, Assignment, Bitwise, Logical, Membership, Identity), operator precedence

Unit 2	Data Types and Flow Control	10 Lectures

2.1 Numbers, Strings, List, Tuple, Set, Dictionary
2.2 Data type conversion
2.3 Decision Making (if, for, while, nested loops, control statements, types of loops)

Unit 3	Array and Matrices	5 Lectures

3.1 The NumPy Module
- 3.1.1 Creating Arrays and Matrices
- 3.1.2 arange(start, stop, step, dtype = None)
- 3.1.3 linspace(start, stop, number of elements)
- 3.1.4 zeros(shape, datatype)
- 3.1.5 ones(shape, datatype)
- 3.1.6 random.random(shape)
- 3.1.7 reshape(array, newshape)

Unit 4	Functions	15 Lectures

4.1 Function Definition
4.2 Function Calling
4.3 Function Arguments (Required Arguments, Keyword Arguments, Default Arguments, Variable Length Arguments)
4.4 Anonymous Functions (Lamda Functions)
4.5 Recursive Functions
4.6 Function with more than one return value

Unit 5	Modules and Packages	15 Lectures

5.1 Built-in Modules
5.2 Creating Modules
5.3 Import Statement (import with renaming, from..import statement, import all names)
5.4 Locating Modules (PYTHONPATH variable)
5.5 Namespaces and Scope
5.6 The dir() function
5.7 Packages in Python (importing modules from a Package)
5.8 Date and Time Modules (time module, calendar module, datetime module)

Unit 6	File Handling	10 Lectures

6.1 Opening a file (modes of opening a file, attributes of files object)
6.2 Closing a file, writing to a file, reading from a file
6.3 File Methods
6.4 Renaming a File, Deleting a File
6.5 Directories in Python (mkdir(), chdir(), getcwd(), rmdir() methods)

Reference Books:

1. O'Connor, T. J. Violent Python: A Cookbook for Hackers, Forensic Analysts, Penetration Testers and Security Engineers. Newnes, 2012.
2. Zelle, J.M., 2004. Python programming: an introduction to computer science. Franklin, Beedle & Associates, Inc.
3. Seitz, J., 2014. Black Hat Python: Python Programming for Hackers and Pentesters. No Starch Press.
4. Yates, J., 2016. Python: Practical Python Programming for Beginners and Experts (Beginner Guide).
5. Sanders, E., 2016. Python: The Python Quickstart Guide-The Ultimate Guide to Python Programming. CreateSpace Independent Publishing Platform.
6. Tale, S., 2016. Python: The Ultimate Beginners Guide Start Coding Today. CreateSpace Independent Publishing Platform.
7. Dawson, M., 2010. Python Programming for the Absolute Beginner 3e. Nelson Education.
8. Ashok Namdev Kamthane, Amit Ashok Kamthane, "Programming and Problem Solving with Python" , Mc-Graw Hill Education,2018.
9. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016.
10. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
11. Timothy A. Budd," Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
12. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
13. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013.

E-BOOKS AND ONLINE LEARNING MATERIAL

1. www.mhhe.com/kamthane/python
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, second edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

CDS-116 Lab Course on Python Programming
List of Practical's

1. Implement simple python programs using interactive and script mode.
2. Develop python programs using id () and type () functions.
3. Implement range () function in python.
4. Implement various control statements in python.
5. Develop python programs to perform various string operations like concatenation, slicing, Indexing.
6. Demonstrate string functions using python.
7. Implement user defined functions using python.
8. Develop python programs to perform operations on list.
9. Implement dictionary and set in python.
10. Develop programs to work with Tuples.
11. Create programs to solve problems using various data structures in python.
12. Implement python program to perform file operations.
13. Implement python programs using modules and packages.

Examples: Write a Python program to:

1. Get a string from a given string where all occurrences of its first character have been changed to '$', except the first character itself.
2. Change a given string to a new string where the first and last characters have been exchanged.
3. Remove the nth index character from a non-empty string.
4. Sort (ascending and descending) a dictionary by value.
5. Shuffle and print a specified list.
6. Merge two python dictionaries.
7. Accept a string and calculate the number of digits, letters and other characters.
8. A program that takes two digits m(row) and n (column) as input and generates a two-dimensional array. Read the elements and display the array.
9. A program that accepts a range of numbers (n to m) and list down all the even/odd numbers to be printed in a comma separated sequence.
10. A function that generates all the factors of a number.
11. Function to find the sum of digits of a number.
12. Function to find GCD/LCM of 2 numbers.
13. Function to concatenate two strings.
14. Program to display Fibonacci series using recursion.
15. Convert decimal to binary using recursion.
16. Calculate the number of upper-case letters and lower-case letters in a string. Import the module to calculate number of upper-case letters and lower-case letters from a string input by the user.
17. Take a list and return a new list with unique elements of the first list. Import the module and input a list to find the unique elements in a list.
18. Capitalize each word in a file.
19. Delete comment lines from a file.
20. Search a word and replace with another word for all the occurrences.
21. A program to read a file in reverse order. The last sentence should be read first and continue till the first sentence is read.
22. Insert a sentence into a specified position of a file.

CDS-113: Basic Mathematical Techniques		
Teaching Scheme 5 Lectures / week	No. of Credits: 4	Examination Scheme CA : 30 marks ESE: 70 marks

Prerequisites:

1. Sets, subsets, standard set operations: union, intersection, complement, symmetric difference, cartesian products, power sets; Algebraic laws etc.
2. Relations, binary relations; properties of relations: reflexivity, symmetry, anti-symmetry, transitivity; equivalence relation, equivalence classes and partitions; One-one, onto, and bijective function, domain and codomain etc.
3. Orders, partial orders, and linear orders; chains; product and lexicographic order on cartesian products; upper and lower bounds, lub and glb etc.

Course Objectives:

1. Introduce concepts of mathematical logic for analyzing propositions, proving theorems, solving a variety of problems and its applications.
2. Evaluate elementary mathematical arguments and identify fallacious reasoning.
3. Understand and apply mathematical foundations, computing and domain knowledge for the conceptualization of computing models from defined problems.
4. Model and analyze computational process using analytic and combinatorial methods.

Course Outcomes: Learner will be able to

1. Express mathematical properties via the formal language of propositional logic.
2. Acquire ability to describe computer programs in a formal mathematical manner.
3. Apply basic counting techniques to solve combinatorial problems;
4. Apply variety of methods for explaining, summarizing and presenting data and interpreting results clearly; and
5. Apply concepts of graphs and trees to tackle real situations such as connectivity and constraint satisfaction, e.g., scheduling.

Course Contents

Unit 1	Matrices and System of Linear Equations	10 Lectures

1.1 Revision of elementary matrices, Matrix operations
1.2 Eigenvalues and Eigenvectors, Rank of matrix
1.3 Echelon form of matrix, System of linear equations
1.4 Gaussian Elimination Method, Gauss–Jordan Elimination Method
1.5 LU Decomposition Method.

Unit 2	Logic and Boolean Algebra	14 Lectures

2.1 Propositional logic
2.2 Equivalences
2.3 Predicates and Quantifiers
2.4 Rules of inference
2.5 Poset, Hasse diagram
2.6 Lattices, Complemented lattice, Bounded lattice and Distributive lattice,
2.7 Boolean functions, Boolean identities, Boolean algebra
2.8 Representation of Boolean functions, Logic gates

Unit 3	Graphs and Trees	14 Lectures

3.1 Graphs and Graph Models
3.2 Graph Terminology and Special Types of Graphs
3.3 Representing Graphs and Graph Isomorphism
3.4 Connectivity
3.5 Eulerian and Hamiltonian Paths
3.6 Shortest-Path Problems

3.7 Planar Graphs
3.8 Introduction to Trees, Applications of Trees, Tree Traversal
3.9 Spanning Trees, Minimum Spanning Trees

Unit 4	**Divisibility in Integers**	**12 Lectures**

4.1 Well ordering principle, First and second principle of mathematical induction
4.2 Division Algorithm, Divisibility and its properties
4.3 Prime numbers, G.C.D. and L.C.M.
4.4 Euclidean Algorithm
4.5 Relatively prime integers
4.6 Euclid's lemma and its generalization
4.7 Congruence relation, Residue classes
4.8 Euler's and Fermat's Theorems

Unit 5	**Permutations and Combinations**	**10 Lectures**

5.1 Cardinality of a Set
5.2 Basics of counting
5.3 Rules of sum and product
5.4 Permutations and combinations
5.5 Binomial coefficients and identities
5.6 Generalized permutations and combinations
5.7 Recurrence relations

Reference Books:

1. Kenneth Rosen, Discrete Mathematics and It's Applications (Tata McGraw Hill)
2. C. L. Liu, Elements of Discrete Mathematics, (Tata McGraw Hill)
3. John Clark and Derek Holton, A First Look at Graph Theory (World Scientific)
4. Narsingh Deo, Graph Theory with Applications to Computer Science and Engineering, (Prentice Hall)
5. H. Anton and C. Rorres, Elementary Linear Algebra with Applications, Seventh Ed., Wiley, (1994).
6. B. Kolman, R. Busby, S. C. Ross, Nadeem-ur-Rehman, Discrete Mathematics Structure, Pearson Education, 5th Edition.
7. N. Biggs, Discrete Mathematics, 3rd edition, Oxford University Press.

CDS-117 Lab Course on Basic Mathematical Techniques
List of Practical's

Practical 1	Eigenvalue, Eigenvector, Rank of matrix, Echelon form of matrix, System of linear equations.
Practical 2	Gaussian Elimination Method, Gauss–Jordan Elimination Method and LU Decomposition Method.
Practical 3	Propositional logic, Equivalences, Predicates and Quantifiers, Rules of inference
Practical 4	Poset, Hasse diagram, Lattices, Complemented lattice, Bounded lattice and Distributive lattice
Practical 5	Boolean functions, Boolean identities, Boolean algebra, Representation of Boolean functions, Logic gates.
Practical 6	Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism
Practical 7	Connectivity, Eulerian and Hamiltonian Paths, Shortest-Path Problems, Planar Graphs.
Practical 8	Trees, Applications of Trees, Tree Traversal, Spanning Trees, Minimum Spanning Trees.
Practical 9	Well ordering principle, First and second principle of Mathematical Induction, Division Algorithm, Divisibility and its properties, Prime numbers, G.C.D. and L.C.M.
Practical 10	Euclidean Algorithm, Relatively prime integers, Euclid are Lemma and its generalization, Congruence relation, Residue classes, Euler's and Fermat's Theorems.
Practical 11	Cardinality of a Set, Basics of counting, Rule of sum and product, Permutations and combinations.
Practical 12	Binomial coefficients and identities, Generalized permutations and combinations, Recurrence relation.

CDS-114: Basic Statistical Techniques for Computer Science

Teaching Scheme	No. of Credits: 4	Examination Scheme
5 Lectures / week		CA : 30 marks UA: 70 marks

Course Objectives: -

1. To acquaint students with some basic concepts in Statistics useful in computer science.
2. To acquaint students with univariate and bivariate data, their plotting, summarizing, describing etc.
3. To introduce to the students the basic concepts of probability.
4. To introduce to the students some of the probability distributions, their shapes, properties and applications in real life.
5. To test various hypotheses of significance.

Course Outcomes: - Student will be able to:-

1. To compute various and interpret various summary statistics
2. To compute the correlation coefficient and regression coefficients and interpret them
3. To interpret the nature of different types of the probability distributions.
4. To use probability distributions for understanding the nature of a given data.
5. To statistically test various hypotheses and make decisions.

Course Contents

Unit 1 | Basic tools for looking at the data | 6 Lectures

1.1. Plotting the data: Different types of plots, Line chart, Pie chart, Bar charts (stacked, grouped), Dual axis chart, bubble chart, heat map, map-based plots
1.2. Summarizing the data: Measures of Central tendency: mean, mode, median, maximum, minimum, quartiles, deciles, percentiles
1.3. Measures of dispersion: Concept of dispersion and variability of data, Measures of variability such as Range, Inter-quartile range, Variance, Standard Deviation, Coefficient of Variation.
1.4. Box plots and interpretation
1.5. Numerical/Graphical problems.

Unit 2 | Moments and shapes of distributions of data | 6 Lectures

2.1 Histogram and frequency distribution (grouped as well as ungrouped)
2.2 Symmetry of a frequency distribution, skewness, positive and negative skewness,
2.3 Measures of skewness-Pearson's measure, Bowley's measure, β_1, γ_1.
2.4 Tail behavior of a distribution, Kurtosis of a distribution, Measure of kurtosis (β_2, γ_2) based on higher order moments (up to 4^{th} order), types of kurtosis: leptokurtic, platykurtic and mesokurtic.
2.5 Numerical/Graphical problems.

Unit 3 | Basic tools for looking at relationships (Bivariate data) | 10 Lectures

3.1 Bivariate data, Scatter diagram, Correlation, Positive correlation, Negative correlation, zero correlation.
3.2 Correlation and causality (basic ideas)
3.3 Karl Pearson's coefficient of correlation (r), Coefficient of determination (r^2).
3.4 Strength of relationship for categorical variables and ranks: Kendall's tau, Rank correlation
3.5 Regression: What is regression? Why regression? Illustrations and applications of regression and correlation.
3.6 Linear Regression
3.7 Properties of regression coefficients: $b_{xy}.b_{yx} = r^2$, $b_{yx}.b_{xy} < 1$, $b_{yx} = r(\sigma_y/\sigma_x)$ and $b_{xy} = r(\sigma_x/\sigma_y)$ [statement only]
3.6 Introduction to nonlinear regression models, second degree curve, growth curve models.
3.7. Numerical problems/Graphical interpretations.

Unit 4	Basics ideas of Probability	10 Lectures

4.1 Random Experiment, Sample Spaces (finite and countably infinite) Events: types of events, Operations on events (Basic set theory results including algebra of set operations need to be reviewed).
4.2 Probability - classical definition, probability models, axioms of probability, axiomatic definition, probability of an event, various computations of probability.
4.3 Concept and definition of: independence of two events, conditional Probability. Applications of conditional probability
4.4 Multiplication theorem, Bayes' theorem (without proof), Concept of Posterior probability. Examples and applications
4.5 Numerical problems involving applications of above probability concepts.

Unit 5	Categorical/count random variables and corresponding probability models	8 Lectures

5.1 Definition of random variable, examples, discrete random variable.
5.2 Definition of probability mass function (p.m.f.), distribution function and its properties. Definition of expectation and variance. Determination of median and mode using p.m.f. Interpretation of mean, variance, mode, median etc. for a distribution
5.3 Discrete Uniform Distribution: The need, properties and applications, mean, variance [statement only]. Examples
5.4 Bernoulli random variable (categorical) , Bernoulli distribution, Properties and applications
5.5 Binomial distribution, sum of Bernoulli random variables, definition, mean, variance, additive property [statement only]. Examples and applications
5.6 Count-type random variables, Poisson distribution: definition, mean, variance, mode, additive property [statement only], Examples and applications. Ideas of equi/over-dispersion
5.7 Numerical and applied problems.

Unit 6	Continuous random variables and some of the probability models	10 Lectures

6.1 Definition of continuous random variable (r. v.), Probability density function (p.d.f.), Cumulative distribution function (c.d.f.), its properties. Calculation of mean, mode, median, variance, standard deviation for continuous r. v., Interpretations of these measures
6.2 Uniform distribution: p.d.f., mean, variance, nature of probability curve [statements only]. Uses and Applications
6.3 Exponential distribution: p.d.f. mean, variance, nature of probability curve, lack of memory property [statement only]. Applications and examples
6.4 Normal distribution: Motivation, p.d.f., mean, variance [statement only], nature of probability density curve, standard normal distribution, computations of probabilities using normal probability table. Uses, applications and examples
6.5 Numerical problems / Graph interpretations.

Unit 7	Basic ideas of statistical testing of hypothesis	10 Lectures

7.1 Concept of population and sample, random sample, SRSWR, SRSWOR, random sample from a probability distribution, parameter, estimator, statistic, standard error of estimator.
7.2 Concept of null hypothesis and alternative hypothesis, type I and type II error critical region, level of significance, one-sided and two-sided tests
7.3 Definition and interpretation of p-value.
7.4 One sample (small) testing problem (location and scale), t-tests, F-test, Assumption of normality
7.5 Two-sample (small) testing problem: t-test (paired) (Asumptions), Normality assumption
7.6 Large Sample Tests. (No derivations)

7.3.1. Ho: $\mu = \mu o$ Vs H1: $\mu \neq \mu o$, $\mu < \mu o$, $\mu > \mu o$ (One sided and two sided tests for mean) [population variance known]

7.3.2 Ho: $\mu 1 = \mu 2$ Vs H1: $\mu 1 \neq \mu 2$, $\mu 1 < \mu 2$, $\mu 1 > \mu 2$ (One sided and two sided Tests for mean) [population variances known]

7.3.3 Ho: P = Po Vs H1: P ≠Po, P < Po, P > Po (One sided and two sided tests for proportions)

7.3.4 Ho: P1 = P2 Vs H1: P1≠P2, P1 < P2, P1 > P2 (One sided and two sided tests for proportions)

Reference Books:

Author Name	Year of Publication	Title	Publisher
David Forsyth	2018	Probability & Statistics for Computer Science	Springer
James L Johnson	2008	Probability & Statistics for Computer Science	Wiley
John E Freund and Benjamin M Perles	2006	Modern Elementary Statistics, 12th Edition	Prentice Hall
Kishor S Trivedi	2008	Probability, Statistics, Design of Experiments and Queuing Theory with Applications of Computer Science, 2nd Ed.	Wiley
Mario F Triola	2012	Modern Elementary Statistics, 12th Edition	Pearson
Michael Baron	2014	Probability & Statistics for Computer Scientists, 2nd Ed.	CRC Press
Norman Matloff	2020	Probability & Statistics for Data Science : Math + R + Data	CRC Press
Sheldon M Ross	2010	A First Course In Probability 8th Edition	Pearson Prentice

CDS-118 : Lab Course on Basic Statistical Techniques For Computer Science

Practical's Using scientific calculator.

1. Looking at the data: Data Summaries: Measures of Central Tendency.
2. Looking at the Data: Variability in the data: Measures of Dispersion.
3. Symmetry and Tails of a distribution: Measures of skewness and kurtosis.
4. Problems on simple probability, conditional probability, Baye's theorem and I n d e p e n d e n c e of events – Applications
5. Correlation and Linear Regression Analysis
6. Fitting of second degree and exponential type models.
7. Application and Fitting of Binomial distribution.
8. Application and Fitting of Poisson distribution.
9. Application and Fitting of Normal Distribution.
10. Test for Population mean. (Ho: $\mu = \mu o$ Vs H1: $\mu \neq \mu o$, $\mu < \mu o$, $\mu > \mu o$ (One sided and two sided tests) [population variance known]), Test for population means (Ho: $\mu 1 = \mu 2$ Vs H1: $\mu 1 \neq \mu 2$, $\mu 1 < \mu 2$, $\mu 1 > \mu 2$ (One sided and two sided tests) [population variances known])
11. Test for population proportion (Ho: P = Po Vs H1: P ≠Po, P < Po, P > Po (One sided and two sided tests), Test for population proportions (Ho: P1 = P2 Vs H1: P1≠P2, P1 < P2, P1 > P2 (One sided and two sided tests).

Practical's Using MS-Excel

1. Diagrammatic Representation and Descriptive Statistics for raw data.
2. Fitting of linear and non-linear regression.
3. Fitting of Normal, Binomial and Poisson Distributions.

SEMESTER- II

CDS-121: Fundamentals of Cyber Security

Teaching Scheme	No. of Credits: 4	Examination Scheme
5 Lectures / week		CA :30 marks UA: 70 marks

Prerequisites

1. Fundamentals of computer software and hardware.
2. Basic concepts of operating system and networking.
3. Practical knowledge of internet and use of networks.

Course Objectives:-

1. Identify Key concept and Terminology of Cyber Security.
2. Examine the concept of privacy and its legal protections.
3. Explain the primary concepts involving encryption.
4. Perform basic computer forensics.
5. Describe the social implications of cyber security.
6. Understand the risks and benefits of social networks.

Course Outcomes:- Student will be able to :-

1. Evaluate fundamental cyber security concepts, theories, and strategies as they apply to real world case studies.
2. Explain technical and non-technical security solutions on different types of cyber systems.
3. Assess risks, vulnerabilities, and threats to sample cyber systems.
4. Identify attributes associated with cyber security professionals.

Course Contents

Unit 1	Introduction to Cyber Security and various challenges in cyber security	5 Lectures

1.1. Overview of Cyber Security,
1.2. Internet Governance – Challenges and Constraints,
1.3. Cyber Threats: - Cyber Warfare-Cyber Crime-Cyber Terrorism-Cyber Espionage,
1.4. Need for a Comprehensive Cyber Security Policy,
1.5. Need for a Nodal Authority,
1.6. Need for an International convention on Cyberspace.

Unit 2	Cyber Security Vulnerabilities and attacks	10 Lectures

2.1. Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Threat Actors, Attacks, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

Unit 3	Securing Web Application, Services and Servers	7 Lectures

Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

Unit 4	Intrusion Detection and Prevention	12 Lectures

Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

Unit 5	Cryptography and Network Security	10 Lectures
Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.		
Unit 6	**Cyberspace and the Law**	**6 Lectures**
Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013.		
Unit 7	**Cyber Forensics and Incident Management**	**10 Lectures**
Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time, Developing an Incident Management and Response System, Digital Forensics, Business Continuity and Disaster Recovery.		

Reference Books:

1. Cyber security – Attack and Defense Strategies: 2nd Edition Paperback Yuri Diogenes (Author), Erdal Ozkaya (Author)
2. Cyber Security Basics: Protect your organization … (Paperback) by Franke, Don

CDS-125 : Lab Course on Cyber Security
List of Practical's

1: Cyber Security Posture:

Students conduct an 'audit' of their current cyber security behavior and readiness. This includes questions related to their computing devices (e.g., type, OS, version, security software installed, etc.), what files they back up, their home network configuration and how they decide to connect to WiFi networks outside of the home, password management, and social networking.

2: Understanding and Using Cryptography:

Students install software to learn both encryption and steganography. For this various free software can be downloaded that provides full disk encryption, file encryption, and steganography. Students are asked to take screen shots of their activities, encode a message hidden within an image and send it to the instructor, as well as decode a message hidden in an image from the instructor.

3: Understanding the Threat Landscape:

Students need to install anti-malware software and run a comprehensive scan on their computer. This includes downloading and installing free anti-malware software that works with their primary computing device (links are provided), running comprehensive scans of their computer with this software, taking a screen shot of the results, and answering several questions about different types of malware, historical examples of each type of malware, and what it does to a system.

4: Digital Forensics, Data Recovery, and Data Protection:

Students install software that automatically backs up their computer as well as software that allows them to recover previously deleted files. This includes downloading and installing CrashPlan (local backup is free) and PhotoRec (free photo and file recovery tool). Students can be asked to use the photo and file recovery tool and identify anything interesting they found from the scan, including previously deleted files and files they did not know ever existed on their computer in the first place.

5: Privacy, Social Media, and Anonymity on the Web :

Students install https everywhere, the Tor browser, learn about anonymous email services, and research how well they really know their Facebook/any social communication site friends. This includes visiting a few web sites and noting whether or not https is used, then installing https everywhere on compatible browsers and visiting those same websites again. Generally speaking, students should now see that https is being used, when possible. With respect to their Facebook/ any social communication site friends, students had to identify the first 25 friends on their friends

list, how long they have known each of them, how well they know each of their friends, whether or not they met this friend in-person prior to becoming friends on Facebook/ any social communication site, when they last saw this friend in-person (if ever), the last time they spoke to this person on the phone (if ever), and how close of friends they are with each person.

6: Managing Passwords :

Students download and install a password manager and configure it appropriately for use. This includes deciding on a password manager that will suit their particular needs and answering several questions about authentication techniques, including the different factors and what is meant by two-factor authentication.

7 : Break A Caesar Cipher :

Caesar cipher is a type of encryption method that was first used by Julius Caesar to communicate with his officials. This encryption technique is also considered to be one of the first methods which are still effective.
The concept of Caesar cipher is simple — a letter of a given text is replaced by another letter that comes after a number of other alphabets. For example — Test: Apple | Shift: 5 | Ciphertext: FUUQJ.
To build a small web app that can break Caesar cipher.

8 : Packet Sniffing :

Packet Sniffing, which is also known as network traffic analysis is all about taking a look at data packets that are sent across the internet and moves on your network.
There are several tools available that capture packets such as tcpdump, Windump, Wireshark etc that can be used for packet sniffing.

CDS-122: Fundamentals of Digital Communication Systems		
Teaching Scheme 5 Lectures/Week	No. of Credits:4	Examination Scheme CA : 30 marks UA: 70 marks

Prerequisites: -
1. Basic Science concepts

Course Objectives: -
1. To study elementary circuits and systems
2. To understand basic concepts of digital electronics
3. To study basic computer organization
4. To introduce all aspects of electronic communication system
5. To study and understand basics of microprocessor

Course Outcomes: - Student will be able to :-
1. To solve problems on Number systems and their representation
2. To familiarize with logic gates and applications in combinational and sequential circuits
3. To identify the importance of different blocks in electronic communication systems
4. To comprehend the functional units and components of digital computer

Course Contents

Unit 1	Number system and Digital Codes	8 Lectures

Number Systems: Decimal, Binary, Octal, Hexadecimal, Binary Coded Decimal number, inter-conversions, Gray Codes, Gray to Binary and Binary to Gray conversion, Alphanumeric representation in ASCII codes, 1's & 2's complement, Binary Arithmetic: addition, subtraction.

Unit 2	Introduction to Logic gates	8 Lectures

Logic Gates: AND, OR, NOT, NOR, NAND & XOR gates, symbols and their Truth tables, Rules and laws of Boolean algebra, De Morgan's theorem
Combinational Circuits: half adder, full adder, universal adder-subtractor, Multiplexer (4:1), De-multiplexer (1:4), decoder (2 to 4), encoder (4 to 2), priority encoder, ALU block diagram.

Unit 3	Digital building blocks	8 Lectures

Clocked RS Flip Flop, D Flip Flop, J K Flip Flop, Shift registers - SISO, SIPO, PISO, PIPO shift registers, counters, concept of synchronous and asynchronous counter, 3 bit up synchronous counter, 3 bit down synchronous counter

Unit 4	Basics of Computer organization	5 Lectures

Basic Organization of Computers, function of each block, Concept of Address Bus, Data Bus, Control Bus, need of I/O interface, Memory Architecture, Characteristics of Memory System, Types of Memory- ROM (diode matrix ROM) and RAM (SRAM, DRAM)

Unit 5	Microprocessor	6 Lectures

Concept of microprocessor, Instruction cycle operation (fetch, decode execute), Evolution of Microprocessor (8086 to Pentium 4), Features like address, data, bus size, speed, cache capacity, number of parallel instructions executed, Introduction to multicore processors

Unit 6	Introduction to Electronic Communication	10 Lectures

Elements of Communication system, Types of communication: simplex, half duplex, full duplex, baseband and broadband, Serial communication: asynchronous and synchronous,

Concept and need of modulation and demodulation, Digital Modulation technique-PCM, modem, concept of cryptography, block diagram for encryption and decryption.

Unit 7	**Wireless Communication**	**6 Lectures**

Wired and Wireless Communication, concepts of antenna, transmitter, receiver, electromagnetic spectrum, signal and channel bandwidth, working principle of Bluetooth and RFID, Introduction of cellular telephony system, telephony generations- 1G to 5G

Unit 8	**Case studies**	**9 Lectures**

Communication device: Smartphone

Role and function of basic blocks of smartphone: radio frequency receiver and transmitter, digital signal processing, A/D conversion, control processor, SIM card, power control and battery.

Access control systems: Fundamental Aspects of biometry

Biometric versus traditional technologies, Characteristics of biometric system, Classification of biometric systems – physiological and behavioral, Key biometric processes – enrollment, identification and verification, Performance measures used in biometric systems – FAR, FRR, GAR, GRR and EER.

Technological extent: Internet of Things

Definition of IoT, general architecture, Hardware devices for IoT, examples of readymade platforms, sensors and actuators, Concept of Device to device communication technology, IoT applications and challenges

Reference Books:

1. Digital Electronics: R.P. Jain, Tata McGraw Hill
2. Digital Principles and Applications: Malvino Leach, Tata Mc Graw Hill
3. Digital Fundamentals: Floyd, Jain R.P., Pearson Education
4. Mobile Cellular Telecommunications Analog and Digital System by Lee
5. Communication Electronics: Principles and applications by Louis E. Frenzel 3rd edition, TMH Publications
6. Wireless Communications Principles and Practice, Rappaport, Pearson Publication
7. Internet of Things: Principles and Paradigms, Rajkumar Buyya and Dastjerdi, MK publishers
8. Computer System Architecture: Morris Mano, Prentice Hall of India
9. The Intel Microprocessors: Barry Brey, Pearson Education Asia
10. Biometrics: Samir Nanavati, Micheal Thieme, Raj Nanavati, Wiley India Pvt. Ltd.

CDS 126: Lab Course on Fundamentals of Digital Communication Systems

The practical course consists of **10 experiments** out of which one will be activity equivalent to 2 practical sessions.
Activity will carry 15% marks at internal and external semester examination.
Activity can be any one of the following:
1.Hobby projects
2.Industrial visit / live work experience
3.PCB Making
4.Market Survey of Electronic Systems
5.Circuit Simulations and CAD tools

Minimum 8 practical out of the following:

1. Study of Logic Gates (Verification of Truth tables)
2. Study of Half Adder and Full Adder using Logic Gates.
3. Study of Decimal to BCD/ (Binary) Converter.
4. Study of Multiplexer and Demultiplexer (4:1 & 1:4).
5. Study of RS, JK and D flip flops using NAND gates
6. 4-bit binary parallel adder and subtractor using IC7483
7. Study of Four bit ALU
8. Study of 4-bit SISO Shift register
9. Study of asynchronous Up/Down Counter
10. Study of Diode Matrix ROM
11. Study of read and write action of RAM (using IC 2112/4 or equivalent)
12. Demonstration of PCM/delta modulation
13. Demonstration of FSK technique
14. Study of Computer hardware system
15. Simulation experiment using PSpice or any equivalent software (any of the above experiment)

CDS-123 : Computer Networks

Teaching Scheme	No. of Credits:4	Examination Scheme
5 Lectures / week		CA :30 marks UA: 70 marks

Prerequisites: Computer Fundamentals

Course Objectives: -

1. To prepare students with basic networking concept.
2. To understand process of data communication using protocols and standards
3. To learn various topologies and applications of network.
4. To understand the concept of network layer, transport layer and application layer

Course Outcomes: - Student will be able to :-

1. Understand the concept of OSI Reference Model and TCP/IP.
2. To know the components of the Network.
3. Understand top down approach of data communication from one user to another user
4. To detect the IP address and route.

Course Contents

Unit 1	Network Model	6 Lectures

Introduction to OSI Model with all layers and Devices required at each layer
TCP/IP Protocol Suite
Addressing-Physical, Logical, Port addresses and Special addresses

Unit 2	Physical Layer	14 Lectures

Analog and Digital data, Analog and Digital signals, Digital Signals-Bit rate, Bit length
Baseband Transmission, Broadband Transmission
Transmission Impairments– Attenuation, Distortion and Noise
Data Rate Limits– Noiseless channel: Nyquist's bit rate, noisy channel : Shannon'slaw
Performance of the Network Bandwidth, Throughput, Latency(Delay),Bandwidth – Delay Product, Jitters
Line Coding Characteristics, Line Coding Schemes–Unipolar -NRZ,Polar-NRZ-I, NRZ-L, RZ, Manchester and Differential Manchester, Problems
Transmission Modes, Parallel Transmission and Serial Transmission–Asynchronous and Synchronous
Switching-Circuit Switching, Message Switching and Packet Switching

Unit 3	Data Link Layer	16 Lectures

Framing–Concept, Methods–Character Count, Flag bytes with Byte Stuffing, Starting & ending Flags with Bit Stuffing
Error detection code – Hamming Distance, CRC
Elementary data link protocols - Simplex stop & wait protocol, Simplex protocol for noisy channel, PPP, HDLC
Sliding Window Protocols – 1-bit sliding window protocols, Pipelining – Go-Back N and Selective Repeat
Random Access Protocols - ALOHA– pure and slotted, CSMA-1- persistent, p-persistent and non-persistent CSMA/CD,CSMA/CA
Controlled Access - Reservation, Polling and Token Passing
Channelization – Definitions – FDMA, TDMA and CDMA

Unit 4	Network Layer	10 Lectures

IPv4 addresses: Address space, Notation, Classful addressing, Classless addressing, NAT, Sub netting, Super netting
IPv4: Datagram, Fragmentation, checksum, options
IPv6 addresses: Structure, address space, IPv6:packet format, Extension headers

Unit 5	Transport Layer and Application Layer	14 Lectures
Process-to-Process Delivery, Multiplexing and De-multiplexing User Datagram Protocol(UDP) - Datagram Format, Checksum, Transmission Control Protocol (TCP) - TCP Services –Process to-Process Communication, Stream Delivery Service, Sending and Receiving Buffers, Segments, Full –Duplex Communication, Connection oriented service, Reliable service TCP Features, TCP Segment Format TCP Vs UDP Introduction to application layer Protocol: Domain Name System (DNS) , WWW – Architecture, HTTP Transaction		
Reference Books:		
1. Data Communications and Networking by Behrouz Forouzan, Fifth Edition, ISBN 978-0-07-337622-6 McGraw Hill. 2. Computer Networks, ANDREW S. Tanenbaum, Fifth Edition, ISBN-13: 978-0-13-212695-3, Pearson		

CDS-127: Lab Course on Computer Networks (CDS-123)

Practical 1:
Execute the following commands and write their outputs:

hostname	hostname –d
hostname –f	hostname –I
ping	netstat
netstat –a	dig
host	netstat –at
netstat –au	netstat –l
netstat –lt	netstat –lu
netstat –s	netstat –st
iwconfig	netstat –su
traceroute, tracepath	ifconfig
ifconfig –a	ifconfig eth()
nslookup	telnet

Practical 2:
Study the following Network Devices in Detail and write their functions:

Repeater

Hub

Switch

Bridge

Router

Gateway

Practical 3:

Study of LAN environment:
Study the concept of MAC addresses, IP addresses.
Find out information about the network in your lab and fill in details below:
1. Total Number of computers in your lab:
2. Find details of any 5 computers :

MAC address	IP address	LAN speed	hostname

3. Are the IP addresses assigned to the machines statically or dynamically?
4. Does the network have a DHCP server?
5. If yes, what is the address of the server ?

Practical 4:

Study of network Cables:

a. Type :
b. Is it coaxial / twisted pair or fiber optic cable ?
c. Cable bandwidth
d. Maximum cable length limit
e. Connector used
f. Swtiches types
g. Router IP address

Practical 5:

Study of network topology;

Draw the Network Topology (show how machines and servers are connected using connectivity devices).

Practical 6:

Build a Simple Server using Python

The following are the socket server methods available in Python.

- s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
- s.bind(): Binds address (hostname, port number) to socket.
- s.listen(): Sets up and starts TCP listener.
- s.accept(): Accepts TCP client connection.

We will follow the following steps:

- Create a socket.
- Bind the socket to a port.
- Start accepting connections on the socket.

The server program is as follows.

```
import socket
import sys

# Create a TCP/IP socket
sock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)

# Define host
host = 'localhost'

# define the communication port
port = 8080

# Bind the socket to the port
sock.bind((host, port))
# Listen for incoming connections
sock.listen(1)
```

```
# Wait for a connection
print 'waiting for a connection'
connection, client = sock.accept()

print client, 'connected'

# Receive the data in small chunks and retransmit it

data = connection.recv(16)
print 'received "%s"' % data
if data:

  connection.sendall(data)
else:
  print 'no data from', client


# Close the connection
connection.close()
```

The server is now ready for incoming connections.

Now run the client and server programs in separate terminal windows, so they can communicate with each other.

Server Output

```
$ python server.py
waiting for a connection
('127.0.0.1', 47050) connected
received "message"
```

Client Output

```
$ python client.py
connecting
message
socket closed
```

CDS-124 : Programming in C

Teaching Scheme	No. of Credits: 4	Examination Scheme
5 Lectures / week		CA :30 marks UA: 70 marks

Prerequisites: None

Course Objectives: -

1. To develop the basic concepts and terminology of programming in general.
2. To implements the algorithms and program in C language
3. To develop programming skills to a level such that problems of reasonable complexity can be tackled successfully.

Course Outcomes: - Student will be able to :-

1. Devise computational strategies for developing applications
2. Develop applications (Simple to Complex) using C programming language

Course Contents

Unit 1	C fundamentals	8 Lectures

History of 'C' language, Features of C, Structure of C Program, C Character Set, Identifiers and Keywords, Variables and constants
Data types- Basic data types, Enumerated types, Type casting, Declarations, Expressions
Operators and Expressions Unary and Binary arithmetic operators, Increment Decrement operators
Relational and logical operators, Bit wise operators, Assignment operators, Comma operator, size of operator, Ternary conditional operator, Precedence and associatively.

Unit 2	Input Output Statements	5 lectures

Input output functions:
printf, scanf functions, getchar, putchar, getch functions, gets, puts functions, Escape sequence characters, Format specifiers

Unit 3	Control and Iterative structures	15 Lectures

Decision making structures:- if ,if-else, switch and conditional operator, Loop control structures:- while ,do while, for, Use of break and continue, Nested structures, Unconditional branching (goto statement).

Unit 4	Functions	16 Lectures

Concept of function, Advantages of Modular design, Standard library functions,
User defined functions:- declaration , definition, function call, parameter passing (by value), return statement.
Recursive functions. Storage Classes – Auto, Static, Global and Register

Unit 5	Arrays	16 Lectures

Concept of array.
Types of Arrays – One , Two and Multidimensional array.
Array Operations - declaration, initialization, accessing array elements.
Memory representation of two-dimensional array (row major and column major)
Passing arrays to function, bound checking
Array applications - Finding maximum and minimum, Counting occurrences
Sorting an array (Simple exchange sort, bubble sort), Matrix operations (trace of matrix, addition, transpose, multiplication, symmetric, upper/ lower triangular matrix)
Arrays and functions

Reference Books:

1. C: the Complete Reference, Schildt Herbert, 4th edition, McGraw Hill
2. A Structured Programming Approach Using C, Behrouz A. Forouzan, Richard
    a. F. Gilberg, Cengage Learning India
3. The 'C' programming language, Brian Kernighan, Dennis Ritchie, PHI
4. Programming in C ,A Practical Approach, Ajay Mittal , Pearson
5. Programming with C, B. Gottfried, 3rdedition, Schaum's outline Series, Tata McGraw Hill.
6. Programming in ANSI C, E. Balagurusamy, 7th Edition, McGraw Hill.

CDS-116: Lab Course on C Programming (CDS-112)

Practical 1:
Use of data types, simple operators (expressions)

1. Accept temperatures in Fahrenheit (F) and print it in Celsius(C) and Kelvin (K) (Hint: C=5/9(F- 32), K = C + 273.15)
2. Accept initial velocity (u), acceleration (a) and time (t). Print the final velocity (v) and the distance (s) travelled. (Hint: $v = u + at$, $s = u + at^2$)
3. To calculate the area of square, rectangle, circle.
4. Accept two numbers and print arithmetic and harmonic mean of the two numbers (Hint: AM= (a+b)/2 , HM = ab/(a+b))
5. Accept three dimensions length (l), breadth(b) and height(h) of a cuboid and print surface area and volume (Hint : surface area=2(lb+lh+bh), volume = lbh)

Practical 2:
Use of decision making statements (if and if-else, nested structures)

1. Write a program to accept an integer and check if it is even or odd.
2. To find the maximum of two numbers and minimum of three numbers.
3. Write a program to accept three numbers and check whether the first is between the other two numbers. Ex: Input 20 10 30. Output: 20 is between 10 and 30
4. Accept a character as input and check whether the character is a digit. (Check if it is in the range '0' to '9' both inclusive)
5. Write a program to accept a number and check if it is divisible by 5 and 7.

Practical 3:
Use of decision making statements (switch case)

1. Accept a single digit from the user and display it in words. For example, if digit entered is 9, display Nine.
2. Write a program, which accepts two integers and an operator as a character (+ - * /), performs the corresponding operation and displays the result.
3. Accept radius from the user and write a program having menu with the following options and corresponding actions

	Actions
1. Area of Circle	Compute area of circle and print
2. Circumference of Circle	Compute Circumference of circle and print
3. Volume of Sphere	Compute Volume of Sphere and print

Practical 4:
Use of simple loops, nested loops

1. Write a program that accepts a number and prints its first digit. Refer sample code 1 given above. Execute the program for different values.
2. Write a program that accepts numbers continuously as long as the number is positive and prints the sum of the numbers read. Refer sample code 2 given above. Execute the program for different values.
3. Write a program to accept n and display its multiplication table. Refer to sample code 3 given above.
4. Write a program to display all prime numbers between 1 and n.(n from user).

Practical 5:

Use of standard library functions and menu driven programs

1. Write a program, which accepts a character from the user and checks if it is an alphabet, digit or punctuation symbol. If it is an alphabet, check if it is uppercase or lowercase and then change the case.
2. Write a menu driven program to perform the following operations till the user selects Exit.
   Accept appropriate data for each option. Use standard library functions from math.h
   i. Sine ii. Cosine iii. Log iv. e^x v. Square Root vi. Exit
3. Accept two complex numbers from the user (real part, imaginary part). Write a menu driven program to perform the following operations till the user selects Exit.
   i. ADD ii. SUBTRACT iii. MULTIPLY iv. EXIT

Practical 6:

Use of user defined and recursive functions)

1. Write a function is Even, which accepts an integer as parameter and returns 1 if the number is even, and 0 otherwise. Use this function in main to accept n numbers and check if they are even or odd.
2. Write a function, which accepts a character and integer n as parameter and displays the next n characters.
3. Write a recursive C function to calculate the GCD of two numbers.
4. Write a recursive C function to calculate the factorial of the number.

Practical 7:

Use of arrays (1-d arrays) and functions

1. Write a program to accept n numbers in an array and calculate the average
2. Write a program to accept n numbers in an array and sort the array.
3. Write a program to accept n numbers in the range of 1 to 25 and count the frequency of occurrence of each number.

Practical 8:

Use of multidimensional array(2-d arrays) and functions

1. Write a program to accept a matrix A of size mXn and store its transpose in matrix B. Display matrix B. Write separate functions.
2. Write a program to add and multiply two matrices. Write separate functions to accept, display, add and multiply the matrices. Perform necessary checks before adding and multiplying the matrices.