TIME TABLE

| Time Day	08:00 - 09:00 AM	09:00 - 10:00 AM	10:20 - 11:20 AM	11:20 - 12:20 PM	1:00 - 2:00 PM	2:00 - 3:00 PM	3:00 - 4:00 PM
Monday	DS LAB(A1)/CN LAB(A2)/OS LAB(A3)		CN	DS	DMS	OS	CN
Tuesday	RM	DS	TYL	TYL	DAA	OS	DMS
Wednesday	OS	RM	TYL	TYL	CN	Club Activities	
Thursday	DMS	DAA	TYL	TYL	DAA	Mini Projects	
Friday	DS LAB(A2)/CN LAB(A3)/OS LAB(A1)		OS	DS	DMS	DAA	CN
Saturday	DS LAB(A3)/CN LAB(A1)/OS LAB(A2)		Events		TYL	TYL	DS

For Queries
Click/Scan
to connect Aditya

NOTES
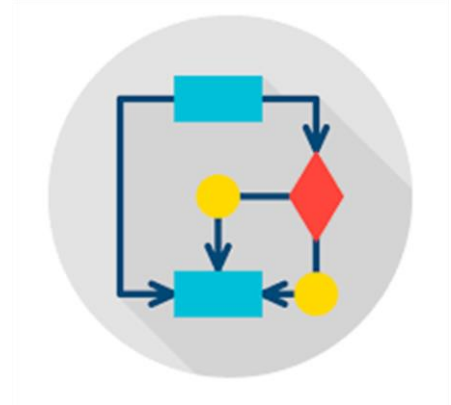
MATHEMATICAL FOUNDATION FOR COMPUTER APPLICATIONS
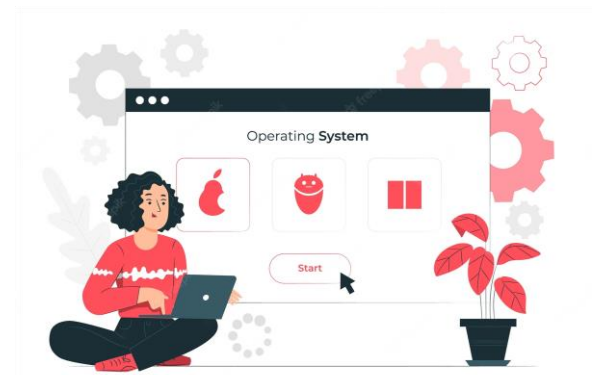
DESIGN AND ANALYSIS OF ALGORITHMS
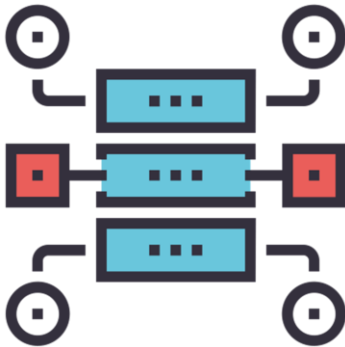
DATA STRUCTURES

RESEARCH METHODOLOGY AND IPR

COMPUTER NETWORKS

OPERATING SYSTEM CONCEPTS

For Queries
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SEMESTER 1		
1.	22MCA11	Mathematical Foundation for Computer Applications
2.	22MCA12	Operating System Concepts
3.	22MCA13	Data Structures
4.	22MCA14	Computer Networks
5.	22RMI18	Research Methodology and IPR
6.	22MCA15	Design and Analysis of Algorithms
7.	22MCAL16	Data Structures with Algorithms Laboratory
8.	22MCAL17	Computer Networks Laboratory
9.	22AUD19	BOS recommended ONLINE courses
10	22MCA110-BC*	Basics of Programming & CO
SEMESTER 2		
1.	22MCA21	Database Management System
2.	22MCA22	Object Oriented Programming Using Java
3.	22MCA23	Software Engineering
4.	22MCA24	Web Technologies
5.	22MCA25x	Professional Elective 1
6.	22MCA26x	Professional Elective 2
7.	22MCAL27	DBMS Laboratory
8.	22MCAL28	Java Programming Laboratory
9.	22MCA29	SEMINAR
10	22AUD210	BOS recommended ONLINE courses
SEMESTER 3		
1.	22MCA31	Data Analytics Using Python
2.	22MCA32	Internet of Things
3.	22MCA33X	Professional Elective 3
4.	22MCA34	Open elective Courses 1
5.	22MCAL36	Data Analytics Lab with Mini-project
6.	22MCAL37	IoT Laboratory with Mini Project
7.	22MCAL38	Societal Project
8.	22MCAL35	Project Work Phase 1
9.	22MCA39	Internship
SEMESTER 4		
1.	22MCA41	Advances in Web Technologies
2.	22MCA42X	Professional Elective 4
3.	22MCA43X	Professional Elective 5
4.	22MCA44	SEMINAR (on Project work phase -2)
5.	22MCA45	Project work phase -2

Professional Elective 1

Course Code under 22MCA25X	Course title
22MCA251	Computer Graphics with Open GL
22MCA252	Data Mining and Business Intelligence
22MCA253	Enterprise Resource Planning
22MCA254	User Interface Design
22MCA255	Optimization Techniques

Professional Elective 2

Course Code under 22MCA26X	Course title
22MCA261	Cryptography and Network Security
22MCA262	Artificial Intelligence
22MCA263	Mobile Application Development
22MCA264	Distributed operating System
22MCA265	Natural Language Processing

Professional Elective 3

Course Code under 22MCA33X	Course title
22MCA331	Block chain Technology
22MCA332	Cloud Computing
22MCA333	Digital Marketing
22MCA334	Object Oriented Design
22MCA335	NOSQL

Open Elective 1

Course Code under 22MCA34X	Course title
22MCA341	Data Structures
22MCA342	Fundamentals of Cloud Computing
22MCA343	Basics of Python Programming
22MCA344	Web Programming
22MCA345	E-commerce

	Elective Subject
	Lab Subject
	Other Important Activity

2

HOLIDAYS

VTU HOLIDAYS 2022 (GENERAL)

Date	Day	General Holidays 2022
26-01-2023	Thursday	Republic Day
18-02-2023	Saturday	Maha Shivaratri
22-03-2023	Wednesday	Ugadi Festival
01-04-2023	Saturday	Yearly Closing of Bank Accounts
03-04-2023	Monday	Mahaveera Jayanthi
07-04-2023	Friday	Good Friday
14-04-2023	Friday	Dr. B R Ambedkar Jayanthi,
01-05-2023	Monday	May Day
29-06-2023	Thursday	Bakrid
29-07-2023	Saturday	Last Day of Moharam
15-08-2023	Tuesday	Independence Day
18-09-2023	Monday	Varasiddhi Vinayaka Vrata
28-09-2023	Thursday	Eid-Milad
02-10-2023	Monday	Gandhi Jayanthi
23-10-2023	Monday	Mahanavami, Ayudhapooja
24-10-2023	Tuesday	Vijayadasami
01-11-2023	Wednesday	Kannada Rajyothsava
14-11-2023	Tuesday	Balipadyami, Deepavali
30-11-2023	Thursday	kanakadasa Jayanti
25-12-2023	Monday	Christmas

VTU HOLIDAYS 2022 (RESTRICTED/OPTIONAL)

Date	Day	Restricted Holidays 2022
30-01-2023	Monday	Sri Madvanavami
07-03-2023	Tuesday	Shab-e-Barath
08-03-2023	Wednesday	Holi Festival
30-03-2023	Thursday	Sri Ramanavami
18-04-2023	Tuesday	Shab-e-Qadar
21-04-2023	Friday	Jumat-ul-wida
25-04-2023	Tuesday	Sri Shankaracharya Jayanthi, Sri Ramanujacharya Jayanthi
05-05-2023	Friday	Buddha Poornima
25-08-2023	Friday	Varamahalakshmi Vrata
29-08-2023	Tuesday	Rug-Upakarma, Onam festival
30-08-2023	Wednesday	Yajur-Upakarma
31-08-2023	Thursday	Brahma Shri Narayana Guru Jayanthi
06-09-2023	Wednesday	Sri Krishna Janmastami
08-09-2023	Friday	Kanya Mariyamma Jayanthi
18-10-2023	Wednesday	Tula Sankramana
27-11-2023	Monday	Guru Nanak Jayanti
28-11-2023	Tuesday	Huttari festival

ACADEMIC CALENDAR

February-2023			March-2023	
01.02.23 Wed			**01.03.23 Wed**	A two day workshop on distinct ways of writing research proposals in India(1-2 Mar.`22) – EEE Dept. "Ethical Hacking" by Technotuners club, MCA Dept. Guest Lecture on "Ethical Hacking" - Cyber Jagrookta Diwas by CCoE
02.02.23 Thu			**02.03.23 Thu**	**IAT-2 (BE-I Sem.)** **Finance Club Activity on 'Finance Quiz.-MBA Dept,** **Second Faculty Feedback –BE-I Sem., M.Tech., MBA, MCA 3rd Sem.**
03.02.23 Fri			**03.03.23 Fri**	**IAT-2 (BE-I Sem.)**
04.02.23 Sat	**HOLIDAY**		**04.03.23 Sat**	**HOLIDAY**
05.02.23 Sun	**HOLIDAY**		**05.03.23 Sun**	**HOLIDAY**
10.02.23 Fri	**Cx Test (Odd) BE-III Sem.**		**06.03.23 Mon**	**IAT-2 (BE-I Sem.)** **FDP Math Modeling and Numerical Techniques-Math Dept.** **STTP on Machine Learning with Python (06-03-2023 to 11-03-2023)-CoE-SP**
11.02.23 Sat	**Last working day – BE-III Sem.**		**07.03.23 Tue**	**IAT-2 (BE-I Sem.)** **Second mentoring Feedback – 1st sem.**
12.02.23 Sun	**HOLIDAY**		**08.03.23 Wed**	"Playing with GIT" by Protocol club, MCA Dept. Guest Lecture on Analog VLSI Device Modeling by Dr. S. Preethi/ Sathyabama University - CoE-IC Guest Lecture on "Analog VLSI Device Modeling"-CoE-ICDepartment Newsletter 2022-23 ODD Sem.
13.02.23 Mon	**Commencement of B.E-VIII Sem., MBA, MCA-I Sem.**		**09.03.23 Thu**	Mini Project Exhibition-B.E I Sem. Marketing Club Activity on CMO Factory-MBA Dept. Student seminar on "Graphene – wonder material" by Science Club, Dept. ofChemistry.
14.02.23 Tue			**10.03.23 Fri**	**SAT TT**
15.02.23 Wed			**11.03.23 Sat**	**Guest Lecture on "Data Integration Tools"– MCA Dept.IAT-1 (BE-VIII Sem)**
16.02.23 Thu			**12.03.23 Sun**	**HOLIDAY**
17.02.23 Fri	Guest Lecture on " Cloud Computing And Cloud Services in Corporate "– MCA Dept.		**13.03.23 Mon**	**Lab Internals (BE-I Sem.)** **IAT-3 (M.Tech, MBA, MCA-III Sem.)IAT-1 (MBA, MCA-I Sem.)** **Release of CMRIT 'CONNECT' March 2023.**
18.02.23 Sat	**HOLIDAY: MAHA SHIVARATRI**		**14.03.23 Tue**	**IAT-3 (M.Tech, MBA, MCA-III Sem.)IAT-1 (MBA, MCA-I Sem.)**
19.02.23 Sun	**HOLIDAY**		**15.03.23 Wed**	**IAT-3 (M.Tech, MBA, MCA-III Sem.)IAT-1 (MBA, MCA-I Sem.)**
20.02.23 Mon	LTTP on "Recent Trends and Challenges on Integration of PowerConverters with Electric Vehicle" – EEE Dept.		**16.03.23 Thu**	**IAT-3 (M.Tech, MBA, MCA-III Sem.)IAT-1 (MBA, MCA-I Sem.)**
21.02.23 Tue			**18.03.23 Sat**	**Last Working day- M.Tech, MBA, MCA-III Sem.HOLIDAY**
22.02.23 Wed	Webinar on Career in Innovations and Entrepreneurship-EEE Expert on IoT and Intelligence Network by Dr. Poorani M, ISE Dept. CMRIT- COE DDIoT "Incorporating IoT" by Protocol Club-MCA Dept. Guest lecture on "Embedded Device Development in for Internet of Things" Prof. Susmitha Alamuru, Dept. of ECE, CMRIT, Bangalore, COE-ES		**19.03.23 Sun**	**HOLIDAY**
23.02.23 Thu	Alumni Talk by Ms. Yashaswini on Projects and Innovation-COEMDS		**20.03.23 Mon**	**Commencement of B.E-VI Sem.**
24.02.23 Fri			**22.03.23 Wed**	**HOLIDAY: UGADI**
25.02.23 Sat	**Alumni Meet** Expert talk on Management & Entrepreneurship by Dr. Venkitakrishnan, Former Director ISRO (RETD), Materials & Rocket Manufacturing expert-ISE Dept. Guest Lecture on "Trends in Cyber Security and Data Analytics"– MCA Dept. **Mini Project Exhibition- MCA III Sem.**		**23.03.23 Thu**	**IAT-3 (BE-I Sem.)** **Finance Club Activity on "Best Mutual funds/stocks.'-MBA**
26.02.23 Sun	**HOLIDAY**		**24.03.23 Fri**	**IAT-3 (BE-I Sem.)**
			25.03.23 Sat	**HOLIDAY**
			26.03.23 Sun	**HOLIDAY**
			27.03.23 Mon	**IAT-3 (BE-I Sem.)**
			28.03.23 Tue	**IAT-3 (BE-I Sem.)**
			30.03.23 Thu	**Cx Test- BE I Sem.**
			31.03.23 Fri	**Last Working day- BE-I Sem.**

Date	Activity		Date	Activity
April-2023			**May-2023**	
01.04.23 Sat	**Last Working Day - BE III Sem.**		01.05.23 Mon	**HOLIDAY** **May Day**
02.04.23 Sun			06.05.23 Sat	**GRADUATION DAY**
03.04.23 Mon	**HOLIDAY** **Mahaveera Jayanthi**		07.05.23 Sun	**HOLIDAY**
07.04.23 Fri	**HOLIDAY** **Good Friday**		13.05.23 Sat	**Last Working Day - BE VIII Sem.IAT-3 (BE-VIII Sem)**
13.04.23 Thu			14.05.23 Sun	**HOLIDAY**
14.04.23 Fri	**HOLIDAY** **Dr. B R Ambedkar Jayanthi**		15.05.23 Mon	**Commencement of BE-IV Sem.**
15.04.23 Sat	**IAT-2 (BE-VIII Sem)**		16.05.23 Tue	
16.04.23 Sun	**HOLIDAY**		17.05.23 Wed	
17.04.23 Mon	**Commencement of MBA, MCA-IV Sem.**		18.05.23 Thu	
18.04.23 Tue			19.05.23 Fri	
19.04.23 Wed			20.05.23 Sat	**HOLIDAY**
20.04.23 Thu			21.05.23 Sun	**HOLIDAY**
21.04.23 Fri			22.05.23 Mon	
22.04.23 Sat	**HOLIDAY** **Ramazan**		23.05.23 Tue	
23.04.23 Sun	**HOLIDAY** **BASAVA JAYANTHI /AKSHAYA TRITIYA**		24.05.23 Wed	
24.04.23 Mon	**IAT-2 (MBA, MCA-I Sem.)IAT-1 (BE-VI Sem.)**		25.05.23 Thu	
25.04.23 Tue	**IAT-2 (MBA, MCA-I Sem.)IAT-1 (BE-VI Sem.)**		26.05.23 Fri	
26.04.23 Wed	**IAT-2 (MBA, MCA-I Sem.)IAT-1 (BE-VI Sem.)**		27.05.23 Sat	**HOLIDAY**
27.04.23 Thu	**IAT-2 (MBA, MCA-I Sem.)IAT-1 (BE-VI Sem.)**		28.05.23 Sun	**HOLIDAY**
28.04.23 Fri			29.05.23 Mon	
29.04.23 Sat			30.05.23 Tue	
30.04.23 Sun	**HOLIDAY**		31.05.23 Wed	**Last Working Day - MBA, MCA- I Sem.**

1. Mathematical Foundation for Computer Applications

Course Code	22MCA11	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:
- To introduce the concepts of mathematical logic.
- To introduce the concepts of sets, relations, and functions.
- To perform the operations associated with sets, functions, and relations.
- To relate practical examples to the appropriate set, function, or relation model, and interpret the associatedoperations and terminology in context.
- To use Graph Theory for solving problems.

Module-1

Set Theory and Matrices
Sets, Operations on sets, Cardinality of sets, inclusion-exclusion principle, pigeonhole principle, matrices, finding Eigenvalues and Eigen vectors./// Sets, Functions, Sequences, Sums and Matrices

Module-2

Mathematical Logic
Propositional Logic, Applications of Propositional Logic, Propositional Equivalences Predicates and Quantifiers,Nested Quantifiers, Rules of Inference Introduction to Proofs

Module-3

Relations
Relations and Their Properties, n-ary Relations and Their Application, Representing Relations, Closures of Relations,Equivalence Relations, Partial Orderings

Module-4

Random variable and probability distribution
Concept of random variable, discrete probability distributions, continuous probability distributions, Mean, variance andco-variance and co-variance of random variables. Binomial and normal distribution, Exponential and normal distribution with mean and variables and problems

Module-5

Graph Theory
Graphs and Graphs models, Graph Terminology and Special Types of Graphs, Representing Graphs and GraphIsomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring

Suggested Learning Resources:
Text Books
1. Kenneth H Rosen, "Discrete Mathematics and its Applications", McGraw Hill publications, 7th edition. (Chapters2.1,2.2,2.5, 2.6,6.2,8.5,8.6,10.1 to 10.8)
2. Wolpole Myers Ye "Probability and Statistics for engineers and Scientist" Pearson Education, 8th edition.

References Books
 1. Richard A Johnson and C.B Gupta "Probability and statistics for engineers" Pearson Education.
J.K Sharma "Discrete Mathematics", Mac Millian Publishers India, 3rd edition,2011.

2. Operating System Concepts

Course Code	22MCA12	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10 hours Lab	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:
- It has been expanded to include multicore CPUs, clustered computers, and open-source operating systems.
- It provides significantly updated coverage of virtual machines, as well as multicore CPUs, the GRUB bootloader, and operating-system debugging.
- It provides new coverage of pipes as a form of interprocess communication.
- It adds new coverage of programming for multicore systems.
- It adds a discussion of mutual exclusion locks, priority inversion, and transactional memory.
- It updates the Solaris example to include Solaris 10 memory managernent.

MODULE-1

OVERVIEW: Introduction, System Structures

MODULE-2

PROCESS MANAGEMENT: Process Concept, Multithreaded Programming

MODULE-3

PROCESS COORDINATION: Synchronization, Deadlocks

MODULE-4

MEMORY MANAGEMENT: Memory-Management Strategies, Virtual-Memory Management

MODULE 5

STORAGE MANAGEMENT: File System

Suggested Learning Resources:
Text Books
1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating Systems Principles, 8th Edition, Wiley –India.

Reference Books
1. D M Dhamdhere: Operating Systems – A Concept Based Approach, 2nd Edition, Tata McGraw – Hill, 2002.
2. P C P Bhatt: Operating Systems, 2nd dition, PHI, 2006.

Harvey M Deital: Operating Systems, 3rd dition, Addison Wesley, 1990.

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

SI.NO	Experiments
1	Write a C program to simulate the following non-preemptive CPU scheduling algorithms to find turnaroundtime and waiting time. a) FCFS b) SJF c) Round Robin (pre-emptive) d) Priority
2	Write a C program to simulate the MVT and MFT memory management techniques.
3	Write a C program to simulate paging technique of memory management.
4	Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance.
5	Write a C program to simulate producer-consumer problem using semaphores.
6	Write a C program to simulate the concept of Dining-Philosophers problem.
7	Write a C program to simulate the following file organization techniques a) Single level directory b) Twolevel directory c) Hierarchical

3. Data Structures

Course Code	22MCA13	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Analyze step by step and develop algorithms to solve real world problems.
- Evaluate the Expressions like postfix, prefix conversions.
- Implementing various data structures viz. Stacks, Queues, Linked Lists, Trees and Graphs.
- Understanding various searching & sorting techniques.
- Be able to compare functions using asymptotic analysis and describe the relative merits of worst-, average-, andbest-case analysis.

Module-1

Classification of Data Structures: Primitive and Non- Primitive, Linear and Nonlinear; Data structure Operations, Stack:Definition, Representation, Operations and Applications: Polish and reverse polish expressions, Infix to postfix
conversion, evaluation of postfix expression, infix to prefix, postfix to infix conversion.

Module-2

Recursion - Factorial, GCD, Fibonacci Sequence, Tower of Hanoi. Queue: Definition, Representation, Queue Variants:Circular Queue, Priority Queue, Double Ended Queue; Applications of Queues. Programming Examples.

Module-3

Linked List: Limitations of array implementation, Memory Management: Static (Stack) and Dynamic (Heap) Memory Allocation, Memory management functions. Definition, Representation, Operations: getnode() and Freenode() operations, Types: Singly Linked List. Linked list as a data Structure, Inserting and removing nodes from a list, Linked implementations of stacks, Header nodes, Array implementation of lists.

Module-4

Trees:Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Additional Binary tree operations. Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching, Application of Trees-Evaluation of
Expression, Programming Examples.

Module-5

Graphs:Definitions, Terminologies, Matrix and Adjacency List Representation Of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search. Insertion Sort, Radix sort, Address Calculation Sort. Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.

Suggested Learning Resources:
Text Books:
1. 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/thinkpython/)
2. Mark Lutz, "Programming Python", O'Reilly Media, 4th edition, 2010.
3. Jake Vander plas, "Python Data Science Handbook: Essential tools for working with data", O'Reilly Publishers, IEdition.
4. Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media, 2012Mark Lutz, "Programming Python", O'ReillyMedia, 4th edition, 2010.
Reference books:

1. Tim Hall and J-P Stacey, "Python 3 for Absolute Beginners", Apress, 1st edition, 2009.
2. Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Apress, Second Edition, 2005.
Shai Vaingast, "Beginning Python Visualization Crafting Visual Transformation Scripts", Apress, 2nd edition, 2014.

4. Computer Networks

Course Code	22MCA14	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:
- Recognize computer networks.
- List computer network topologies.
- List required hardware to constitute computer network.
- Explain each computer network topology physically or logically.

Module-1

Introduction: Data Communications, Networks, The Internet, Protocols & Standards, Layered Tasks, The OSI model,Layers in OSI model, TCP/IP Protocol suite, Addressing

Module-2

Physical Layer-1: Analog & Digital Signals, Transmission Impairment, Data Rate limits, Performance, Digital-digital conversion (Only Line coding: Polar, Bipolar and Manchester coding), Analog-to-digital conversion (onlyPCM), Transmission Modes, Digital-to-analog conversion

Module-3

Physical Layer-2 and Switching: Multiplexing, Spread Spectrum, Introduction to switching, Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks

Module-4

Data Link Layer-1: Error Detection & Correction: Introduction, Block coding, Linear block codes, Cyclic codes, Checksum.

Module-5

Data Link Layer-2: Framing, Flow and Error Control, Protocols, Noiseless Channels, Noisy channels, HDLC, PPP(Framing, Transition phases only)

Suggested Learning Resources:
Text Books:
1. Behrouz A. Forouzan,: Data Communication and Networking, 4th Edition Tata McGraw-Hill, 2006.
Reference books:
1. Alberto Leon-Garcia and Indra Widjaja: Communication Networks - Fundamental Concepts and Key architectures, 2ndEdition Tata McGraw-Hill, 2004.
2. William Stallings: Data and Computer Communication, 8th Edition, Pearson Education, 2007.
3. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.
Nader F. Mir: Computer and Communication Networks, Pearson Education, 2007.

5. Design and Analysis of Algorithms

Course Code	22MCA15	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:
- Explain various computational problem solving techniques.
- Apply appropriate method to solve a given problem.
- Describe various methods of algorithm analysis.

Module-1

Introduction: What is an Algorithm? (T2:1.1), Algorithm Specification (T2:1.2), Analysis Framework (T1:2.1), Performance Analysis: Space complexity, Time complexity (T2:1.3). and notation (o), Mathematical analysis of Non- Recursive and recursive Algorithms⬚), Asymptotic Notations: Big-Oh notation (O), Omega notation (Ω), Theta notation(Littleoh with Examples (T1:2.2, 2.3, 2.4). Important Problem Types: Sorting, Searching, String processing, Graph Problems, Combinatorial Problems. Fundamental Data Structures: Stacks, Queues, Graphs, Trees, Sets and Dictionaries.
(T1:1.3,1.4). RBT: L1, L2, L3

Module-2

Divide and Conquer: General method, Binary search, Recurrence equation for divide and conquer, Finding the maximum and minimum (T2:3.1, 3.3, 3.4), Merge sort, Quick sort (T1:4.1, 4.2), Strassen"s matrix multiplication (T2:3.8), Advantages and Disadvantages of divide and conquer. Decrease and Conquer Approach: Topological Sort. (T1:5.3). Transform and Conquer Approach: Heaps and Heap Sort (T1:6.4). RBT: L1, L2, L3

Module-3

Greedy Method: General method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines (T2:4.1,4.3, 4.5). Minimum cost spanning trees: Prim"s Algorithm, Kruskal"s Algorithm (T1:9.1, 9.2). Single source shortest
paths: Dijkstra's Algorithm (T1:9.3). Optimal Tree problem: Huffman Trees and Codes (T1:9.4). RBT: L1, L2, L3

Module-4

Dynamic Programming: General method with Examples, Multistage Graphs (T2:5.1, 5.2). Transitive Closure: Warshall"s Algorithm, All Pairs Shortest Paths: Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem ((T1:8.2, 8.3, 8.4), Bellman-Ford Algorithm (T2:5.4), Travelling Sales Person problem (T2:5.9), Reliability design
(T2:5.8). RBT: L1, L2, L3

Module-5

Backtracking: General method (T2:7.1), N-Queens problem (T1:12.1), Sum of subsets problem (T1:12.1), Graph coloring (T2:7.4), Hamiltonian cycles (T2:7.5). Programme and Bound: Assignment Problem, Travelling Sales Person problem (T1:12.2), 0/1 Knapsack problem (T2:8.2, T1:12.2): LC Programme and Bound solution (T2:8.2), FIFO Programme and Bound solution (T2:8.2). Probabilistic and Randomized Algorithms: Probabilistic Algorithms Randomizing deterministic Algorithms: Randomizing Probelinsrch quicksort, MonteCarlo Algorithm, Biased Monte Carlo Algorithms: A Montecarlo algorithm for testing polynomial quality, Introduction to Las vegas Algorithms (T3:24.1, 24.2,24.3) NP-Complete and NP-Hard problems: Basic concepts, non deterministic algorithms, P,NP, NP-Complete, and NP-Hard classes (T2:11.1). RBT: L1, L2, L3

Suggested Learning Resources:
Text Books:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 2nd Edition, 2009. Pearson.
2. Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press.
3. Algorithms, Kenneth A Berman and Jerome L Paul, Cengage Learning India Pvt Ltd, 2002 edition.
Reference books:
1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

6. Research Methodology and IPR

Course Code		22RMI18	CIE Marks	50
Teaching Hours/Week (L:P:SDA)		2:0:0	SEE Marks	50
Total Hours of Pedagogy		20	Total Marks	100
Credits		02	Exam Hours	03

Course Learning objectives:
- To give an overview of the research methodology and explain the technique of defining a research problem
- To explain the functions of the literature review in research.
- To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- To explain various research designs and their characteristics.
- To explain the details of sampling designs, measurement and scaling techniques and also different methods of data collections.
- To explain several parametric tests of hypotheses and Chi-square test.
- To explain the art of interpretation and the art of writing research reports.
- To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.
- To discuss leading International Instruments concerning Intellectual Property Rights.

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and
Problems Encountered by Researchers in India.

Module-2

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Module-3

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. Design of Sample Surveys: Introduction, Sample Design, Sampling and Non-
sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Module-4

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of 02.03.2021 updated 17/ 104 Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method. Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout. Types of Reports, Oral Presentation, Mechanics of Writing a
Research Report, Precautions for Writing Research Reports.

Module-5

Intellectual Property (IP) Acts: Introduction to IP: Introduction to Intellectual Property (IP), different types of IPs and its importance in the present scenario, Patent Acts: Indian patent acts 1970.Design Act: Industrial Design act 2000. Copy right acts: Copyright Act 1957. Trade Mark Act, 1999.

Suggested Learning Resources:
Text Books
1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg New Age International 4th Edition, 2018.
2. Research Methodology a step-by- step guide for beginners. (For the topic Reviewing the literature under module 2)Ranjit Kumar SAGE Publications Ltd 3rd Edition, 2011 Study Material.
3. Intelectual property, Debirag E. Bouchoux, Cengage learning, 2013.
References Books
1. Research Methods: the concise knowledge base Trochim, Atomic Dog Publishing, 2005.
   Conducting Research Literature Reviews: From the Internet to Paper
   Fink A Sage Publications, 2009.

7. Basics of Programming & CO

Course Code	**22MCA110**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	20	Total Marks	100
Credits	-	Exam Hours	03

Course Learning objectives:
- To understand the structure, function and characteristics of computer systems.
- To understand the design of the various functional units and components of computers.
- To identify the elements of modern instructions sets and their impact on processor design.
- To explain the function of each element of a memory hierarchy

Module-1

C Programming: decision making, control structures and arrays C Structure, Data Types, Input-Output Statements, Decision making with if statement, simple if statement, the if..else statement, nesting of if..else statements, the else.if ladder, the switch statement, the ?: operator, the goto statement, the break statement, programming examples. The while statement, the do...while statement, the for statement, nested loops, jumps in loops, the continue statement, programming examples. One dimensional and two dimensional arrays, declaration and initialization of arrays, reading, writing and manipulation of above types of arrays.

Module-2

Structures Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, operations on individual members, array of structures, structures within structures, structures and functions, Unions, size of structures.

Module-3

Pointers Pointers in C, Declaring and accessing pointers in C, Pointer arithmetic, Functions , Call by value, Call by reference, Pointer as function arguments, recursion, Passing arrays to functions, passing strings to functions, Functions returning pointers, Pointers to functions, Programming Examples.

Module-4

Binary Systems and Combinational Logic 02.03.2021 updated 24/ 104 Digital Computers and Digital Systems, Binary Numbers, Number Base Conversion, Octal and Hexadecimal Numbers, subtraction using r's and r-1 complements, Binary Code, Binary Storage and Registers, Binary Logic, Integrated Circuits, Digital Logic Gates.

Module-5

Basic Structure of Computer Hardware and Software Computer Types, Functional Units, Basic Operational Concepts, Bus structure, Software, Performance, Multiprocessing and Multi computers, Machine Instruction: Memory Locationsand Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Interrupts.

Suggested Learning Resources:
Text Books
1. Programming in ANSI C,Balaguruswamy, 7th Edition, McGraw Hill Education
2. C : The Complete Reference, Herbert Schild,4th Edition, McGraw Hill Education
3. Let us C, YashwantKanetkar, BPB Publications
4. M.Morris Mano, "Digital Logic and Computer Design", Pearson, 2012.
Carl Hamacher, ZvonkoVranesicSafwatZaky, "Computer Organization", 5th edition, Tata McGraw-Hill, 2011

8. Data Structures with Algorithms Laboratory

Course Code	22MCAL16	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	0:3:0	SEE Marks	50
Credits	1.5	Exam Hours	03

Course objectives:
- Evaluate the Expressions like postfix, prefix conversions.
- Implementing various data structures viz. Stacks, Queues, Linked Lists, Trees and Graphs.

Sl.NO	Experiments
1	Implement a Program in C for converting an Infix Expression to Postfix Expression.
2	Design, develop, and execute a program in C to evaluate a valid postfix expression using stack. Assume that the postfix expression is read as a single line consisting of non-negative single digit operands and binary arithmeticoperators. The arithmetic operators are + (add), - (subtract), * (multiply) and / (divide).
3	Design, develop, and execute a program in C to simulate the working of a queue of integers using an array.Provide the following operations: a. Insert b. Delete c. Display
4	Write a C program to simulate the working of a singly linked list providing the following operations: a. Display& Insert b. Delete from the beginning/end c. Delete a given element
5	Write a C program to Implement the following searching techniques a. Linear Search b. Binary Search.
6	Write a C program to implement the following sorting algorithms using user defined functions: a. Bubble sort (Ascending order) b. Selection sort (Descending order).
7	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm (C programming)
8	From a given vertex in a weighted connected graph, find shortest paths to other vertices Using Dijkstra'salgorithm (C programming)
	Demonstration Experiments (For CIE) if any
9	Using circular representation for a polynomial, design, develop, and execute a program in C to accept twopolynomials, add them, and then print the resulting polynomial.
10	Design, develop, and execute a program in C to evaluate a valid postfix expression using stack. Assume that the postfix expression is read as a single line consisting of non-negative single digit operands and binary arithmeticoperators. The arithmetic operators are + (add), - (subtract), * (multiply) and / (divide).

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:
- Implement the techniques for evaluating the given expression.
- Implement sorting / searching techniques, and validate input/output for the given problem.
- Implement data structures (namely Stacks, Queues, Circular Queues, Linked Lists, and Trees), its operations and algorithms.
- Implement the algorithm to find whether the given graph is connected or not and conclude on the performance of the technique implemented.

9. Computer Networks Laboratory

Course Code	22MCAL17	CIE Marks	50
Teaching Hours/Week (L:P: SDA)	0:3:0	SEE Marks	50
Credits	1.5	Exam Hours	03

Course objectives:
- To understand the working principle of various communication protocols.
- To understand the network simulator environment and visualize a network topology and observe its performance.
- To analyze the traffic flow and the contents of protocol frames.

Sl. NO	Experiments
1	Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped.
2	Implement the data link layer framing methods such as character, character-stuffing and bit stuffing.
3	Write a program to compute CRC code for the polynomials CRC-12, CRC-16 and CRC CCIP
4	Develop a simple data link layer that performs the flow control using the sliding window protocol, and lossrecovery using the Go-Back-N mechanism.
5	Implement Dijsktra's algorithm to compute the shortest path through a network
6	Implement data encryption and data decryption
7	Simulate the network with five nodes n0, n1, n2, n3, n4, forming a star topology. The node n4 is at the centre. Node n0 is a TCP source, which transmits packets to node n3 (a TCP sink) through the node n4. Node n1 is another traffic source, and sends UDP packets to node n2 through n4. The duration of the simulation time is 10seconds.
8	Simulate to study transmission of packets over Ethernet LAN and determine the number of packets dropdestination.
	Demonstration Experiments (For CIE) if any
9	Simulate the different types of internet traffic such as FTP and TELNET over a wired network and analyze thepacket drop and packet delivery ratio in the network.

Course outcomes (Course Skill Set):
At the end of the course the student will be able to:
- Implement data link layer farming methods.
- Analyze error detection and error correction codes.
- Implement and analyze routing and congestion issues in network design.
- Implement Encoding and Decoding techniques used in presentation layer.
- To be able to work with different network tools.

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