Minutes of Board of Studies of Department of CSE and Dept. of Computational Science at University Building III Board Room at 11.30 AM on 31.08.2018

In the beginning of the meeting the chairman of the BOS welcomed all the members and briefed the importance of this BOS meeting.

***Following members were present*:**

1.	**Prof.(Dr.) Devdutta Sinha**	Professor, University of Calcutta
2.	**Prof.(Dr.) Utpal Roy**	Professor , Dept. of CSS, Visva Bharati University
3.	**Mr. Arijit Bhattacharyya**	Founder and CEO , Virtualinfocom
4.	**Prof.(Dr.) Dilip Debnath**	Dean Engineering , Brainware University
5.	**Prof. (Dr.) Sharmistha Ghosh**	Dean Science , Brainware University
6.	**Dr. Sudipto Bhattacharyya**	Associate Professor and Head, Dept. of CSE, Brainware University
7.	**Dr. Soumya Paul**	Associate Professor and Head , Dept. of Computational Science, Brainware University

The Agenda for this BOS meeting was as follows:

Item No. 1: Finalization of Course Structure of M.Tech in Computer Science and Engineering – The BOS discussed the items and modified with their valuable suggestions and finalized it. Some emerging industry oriented computer science topics have been incorporated in the syllabus, which bridges the gap between academia and industry.

Item No. 2: Finalization of Course Structure of M.Sc in Computer Science – The BOS discussed the items and updated with their valuable suggestions and finalized it.

There being no other matter, the meeting was concluded with a vote of thanks to the chair.

Meeting of Board of Studies of Department of CSE and Dept. of Computational Science at University Building III Board Room at 11.30 AM on 31.08.2018

A Board of Study has been formed in the Department of CSE and Department of Computational Science

Agenda:

- Finalisation of Course Structure of M.Tech In Computer Science and Engineering
- Finalisation of Course Structure of M.Sc. in Computer Science

Members:

- Prof.(Dr.) Devdutta Sinha , Professor , University of Calcutta, Email- devadatta.sinha@gmail.com
- Prof.(Dr.) Utpal Roy , Professor , Dept. of CSS, Visva Bharati University, Email- roy.utpal@gmail.com
- Mr. Arijit Bhattacharyya , Founder and CEO , Virtualinfocom , Email- arijit@virtualinfocom.net
- Prof.(Dr.) Dilip Debnath , Dean Engineering , Brainware University
- Prof. (Dr.) Sharmistha Ghosh , Dean Science , Brainware University
- Dr. Sudipto Bhattacharyya , Associate Professor and Head, Dept. of CSE, Brainware University
- Dr. Soumya Paul , Associate Professor and Head , Dept. of Computational Science, Brainware University

Members Present:

Faculty Member	Affiliation/Department	Signature
Prof.(Dr.) Devdutta Sinha	University of Calcutta	31.8.18
Prof.(Dr.) Utpal Roy	Dept. of CSS, Visva Bharati University	31-08-18
Mr. Arijit Bhattacharyya	Founder and CEO , Virtualinfocom	
Prof.(Dr.) Dilip Debnath	Dean Engineering , Brainware University	31.8.18
Prof. (Dr.) Sharmistha Ghosh	Dean Science , Brainware University	31.8.18
Dr. Sudipto Bhattacharyya	Associate Professor and Head, Dept. of CSE, Brainware University	31/8/2018
Dr. Soumya Paul	Associate Professor and Head , Dept. of Computational Science , Brainware University	31.8.18

2018

BRAINWARE UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure: B. Tech. Computer Science & Engineering 2018

Mandatory Induction Program (Duration: 3 weeks)

- Physical activity
- Creative Arts
- Universal Human Values
- Literary
- Proficiency Modules
- Lectures by Eminent People
- Visits to local Areas
- Familiarization to Dept./Branch & Innovations

Different components of Mandatory Induction Program will be implemented as per the guidelines of AICTE.

SEMESTER – I

Course Code	Course Name	L - T - P	Credits	Total Marks
BMAT010101	Calculus	3 - 1 - 0	4	100
BPHY010101	Physics	2 - 1 - 0	3	100
BELE010201	Basic Electrical Engineering	2 - 1 - 0	3	100
BPHY010901	Physics Lab	0 - 0 - 3	1.5	100
BELE010901	Basic Electrical Engineering Lab	0 - 0 - 3	1.5	100
BMEE010901	Engineering Graphics & Design	1 - 0 - 3	3	100
UNSS010701	NSS	0 - 0 - 1	0	0
Total			16	600

SEMESTER – II

Paper Code	Paper Name	L	T	P	Credits	Total Marks
HSMC(CSE)201	English I	2	0	0	2	100
HSMC(CSE)202	Universal Human Values and Ethics	3	0	0	3	100
BSC(CSE)201	Mathematics II	3	1	0	4	100
BSC(CSE)202	Chemistry	2	1	0	3	100
ESC(CSE)201	Programming for Problem Solving	3	0	0	3	100
HSMC(CSE)291	English I Lab	0	0	2	1	100
BSC(CSE)292	Chemistry Lab	0	0	3	1.5	100
ESC(CSE)291	Programming for Problem Solving Lab	0	0	3	1.5	100

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Course Structure: B. Tech. Computer Science & Engineering 2018

ESC(CSE)292	Workshop/ Manufacturing Practices	1	0	3	3	100
MC-2	Environmental Science	1	0	0	0	0
Total					22	900

Course Name: Programming for Problem Solving
Course Code: ESC(CSE)201
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[10L]

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm: steps to solve logical and numerical problems. **Representation of Algorithm:** Flowchart/Pseudocode with examples. From Algorithms to programs; source code, variables (with data types) variables and memory locations , Syntax and Logical Errors in compilation, object and executable code

Module 2
[8L]
Arithmetic expressions and precedence
Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching Iteration and loops
Arrays: Arrays (1-D, 2-D), Character arrays and Strings

Module 3
[10L]
Function: Built in libraries, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference
Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Module 4
[8L]
Structure: Structures, Defining structures and Array of Structures
Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation).

Module 5
[4L]

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure: B. Tech. Computer Science & Engineering 2018

File handling

Suggested Text Books

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Course Name: Programming for Problem Solving Lab
Course Code: ESC(CSE)291
Contact: 3P
Credits: 2
No. of Periods: 24

Module 1

Problem solving using computers: Familiarization with programming environment, Variable types and type conversions, Simple computational problems using arithmetic expressions

Module 2

Branching and logical expressions: Problems involving if-then-else structures, Loops, while and for loops - Iterative problems e.g., sum of series

Module 3

Array: 1D Arrays: searching, sorting, 1D Array manipulation, 2D arrays and Strings, Matrix problems, String operations

Module 4

Functions: call by value, Simple functions, Recursion, structure of recursive calls, Recursive functions Pointers and structures

Module 5

File handling: File operations

SEMESTER – III

Paper Code	Paper Name	L-T-P	Credits	Total Marks
HSMC(CSE)301	English II	2-0-0	2	100
BSC(CSE)301	Mathematics III	2-0-0	2	100
ESC(CSE)301	Analog Electronic Circuits	3-0-0	3	100
ESC(CSE)302	Digital Electronics	3-0-0	3	100
PCC-CS301	Data structure and Algorithms	3-0-0	3	100
PCC-CS302	IT Workshop (Sci Lab/MATLAB)	1-0-0	1	100

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure: B. Tech. Computer Science & Engineering 2018

ESC(CSE)391	Analog Electronic Circuits Lab	0 – 0 – 3	2	100
ESC(CSE)392	Digital Electronics Lab	0 – 0 – 3	2	100
PCC-CS391	Data structure and Algorithms Lab	0 – 0 – 3	2	100
PCC-CS392	IT Workshop (Sci Lab/MATLAB)	0 – 0 – 3	2	100
MC-3	Essence of Indian Traditional Knowledge	1 – 0 - 0	0	0
Total			22	1000

Course Name: Data structure and Algorithms
Course Code: PCC-CS301
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1:
[8L]
Introduction: Basic Terminologies: Elementary **Data Organizations, Data Structure Operations:** insertion, deletion, traversal ~~etc.~~; Analysis of an **Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.**

Module 2:
[9L]
Stacks and Queues: ADT Stack and its operations: **Algorithms and their complexity analysis,** Applications of Stacks: Expression Conversion **and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.**

Module 3:
[7L]
Linked Lists: Singly linked lists: Representation **in memory, Algorithms of several operations:** Traversing, Searching, Insertion into, Deletion **from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.**

Module 4:
[7L]
Sorting and Hashing: Objective and properties of **different sorting algorithms: Selection Sort, Bubble** Sort, Insertion Sort, Quick Sort, Merge Sort, **Heap Sort; Performance and Comparison among all the** methods, Hashing.

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Course Structure: B. Tech. Computer Science & Engineering 2018

Module 5:

[9L]

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Suggested books:

1. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

Suggested reference books:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.

Course Name: IT Workshop (Sci Lab/MATLAB)

Course Code: PCC-CS302

Contact: 1L

Credits: 1

No. of Lectures: 10

Module 1

[1L]

Introduction to MATLAB Programming: Basics of MATLAB programming, Array operations in MATLAB, Loops and execution control, Working with files: Scripts and Functions, Plotting and program output

Module 2

[2L]

Approximations and Errors: Defining errors and precision in numerical methods, Truncation and round-off errors, Error propagation, Global and local truncation errors

Module 3

[3L]

Numerical Differentiation and Integration: Numerical Differentiation in single variable, Numerical differentiation: Higher derivatives, Differentiation in multiple variables, Newton-Cotes integration formulae, Multi-step application of Trapezoidal rule, MATLAB functions for integration

Module 4

[2L]

Linear Equations: Linear algebra in MATLAB, **Gauss Elimination, LU decomposition and partial** pivoting, Iterative methods: Gauss Siedel, Jacobi.

Module 5

[2L]

Nonlinear Equations: Nonlinear equations in single variable, **MATLAB function fzero in single** variable

Fixed-point iteration in single variable, **Newton-Raphson in single variable, MATLAB function fsolve** in single and multiple variables, Newton-Raphson in multiple variables

Suggested books:

1. Fausett L.V. (2007) Applied Numerical Analysis Using MATLAB, 2nd Ed., Pearson Education

Suggested reference books:

1. Chapra S.C. and Canale R.P. (2006) Numerical Methods for Engineers, 5th Ed., McGraw Hill

Course Name: Data structure and Algorithms Lab
Course Code: PCC-CS391
Contact: 3P
Credits: 2
No. of Periods: 24

Module 1

Stacks and Queues: adding, deleting elements **Circular Queue: Adding & deleting elements Merging** Problem, Evaluation of expressions operations on **Multiple stacks & queues**

Module 2

Implementation of linked lists: inserting, deleting, **inverting a linked list. Implementation of stacks &** queues using linked lists: Polynomial addition, **Polynomial multiplication**

Module 3

Sparse Matrices : Multiplication, addition.

Module 4

Trees: Recursive and Non Recursive traversal **of Trees, Threaded binary tree traversal. AVL tree** implementation, Application of Trees. Application **of sorting and searching algorithms**

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure: B. Tech. Computer Science & Engineering 2018

Module 5

Hash tables implementation: searching, **inserting and deleting, searching & sorting techniques.**

Course Name: IT Workshop (Sci Lab/MATLAB)

Course Code: PCC-CS392

Contact: 3P

Credits: 2

No. of Periods: 24

Module 1

Introduction to MATLAB Programming: Basics, Array, Loops and execution control, Files: Scripts and Functions, Plotting and program output

Module 2

Approximations and Errors: Errors and
Precision, Truncation and round-off errors, **Error propagation, Global and local truncation errors**

Module 3

Numerical Differentiation and Integration: Numerical Differentiation in single variable, multiple variables, Newton-Cotes integration formulae, **Multi-step application of Trapezoidal rule**

Module 4

Linear Equations: Gauss Elimination, **LU decomposition and partial pivoting, Iterative methods:** Gauss Siedel , Jacobi

Module 5

Nonlinear Equations: Nonlinear equations **in single variable, Newton-Raphson in single variable,** MATLAB function fsolve in single and multiple **variables, Newton-Raphson in multiple variables**

SEMESTER – IV

Paper Code	Paper Name	L - T - P	Credits	Total Marks
HSMC(CSE)401	Management I	3 – 0 - 0	3	100
PCC-CS401	Computer Organization and Architecture	3 - 0 – 0	3	100
PCC-CS402	Design and Analysis of Algorithm	3 - 0 – 0	3	100
PCC-CS403	Operating Systems	3 - 0 – 0	3	100
PCC-CS404	Discrete Mathematics	3 - 1 – 0	4	100
HSMC(CSE)491	English II Lab	0 – 0 – 2	1	100
PCC-CS491	Computer Organization and Architecture Lab	0 - 0 – 3	2	100
PCC-CS492	Design and Analysis of Algorithm Lab	0 - 0 – 3	2	100

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Course Structure: B. Tech. Computer Science & Engineering 2018

PCC-CS493	Operating Systems Lab	0 - 0 – 3	2	100
PCC-CS494	Linux Administration Lab	0 – 0 – 2	1	100
Total			**24**	**1000**

Course Name: Computer Organization and Architecture
Course Code: PCC-CS401
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[10L]

Functional blocks of a computer: CPU, memory, **input-output subsystems, control unit. Instruction** set architecture of a CPU – registers, instruction **execution cycle, RTL interpretation of instructions,** addressing modes, instruction set. Case study – **instruction sets of some common CPUs.**

Module 2
[9L]

Data representation: signed number **representation, fixed and floating point representations,** character representation. Computer arithmetic – **integer addition and subtraction, ripple carry** adder, carry look-ahead adder, ~~etc.~~ multiplication – **shift-and add, Booth multiplier, carry save** multiplier, ~~etc.~~ Division restoring and non-restoring **techniques, floating point arithmetic.**

Module 3
[8L]

Memory system design: semiconductor **memory technologies, memory organization. Peripheral** devices and their characteristics: **Input-output subsystems, I/O device interface, I/O transfers –** program controlled, interrupt driven and DMA, **privileged and non-privileged instructions, software** interrupts and exceptions. Programs and processes – **role of interrupts in process state transitions,** I/O device interfaces – SCII, USB

Module 4
[7L]

Pipelining: Basic concepts of pipelining, **throughput and speedup, pipeline hazards. Parallel** Processors: Introduction to parallel processors, **Concurrent access to memory and cache coherency.**

Module 5
[6L]

Memory organization: Memory interleaving, **concept of hierarchical memory organization, cache** memory, cache size vs. block size, mapping **functions, replacement algorithms, write policies.**

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure: B. Tech. Computer Science & Engineering 2018

Suggested books:

1. "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.
2. "Computer Organization and Embedded Systems", 6th Edition by Carl Hamacher, McGraw Hill Higher Education.

Suggested reference books:

1. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
2.. "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.
3. "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill

Course Name: Design and Analysis of Algorithm
Course Code: PCC-CS402
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[9L]

Introduction: Characteristics of algorithm. **Analysis of algorithm: Asymptotic analysis of complexity bounds** – best, average and worst-case behavior; **Performance measurements of Algorithm, Time** and space trade-offs, Analysis of recursive **algorithms through recurrence relations: Substitution** method, Recursion tree method and Masters' **theorem.**

Module 2
[7L]

Fundamental Algorithmic Strategies Brute-Force, **Greedy, Dynamic Programming, Branch-and-Bound** and Backtracking methodologies for the **design of algorithms; Illustrations of these techniques for** Problem-Solving , Bin Packing, Knapsack **TSP. Heuristics –characteristics and their application** domains.

Module 3
[10L]

Graph and Tree Algorithms: Traversal algorithms: **Depth First Search (DFS) and Breadth First Search** (BFS); Shortest path algorithms, Transitive **closure, Minimum Spanning Tree, Topological sorting,** Network Flow Algorithm.

Module 4

[8L]

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, **Standard NP-complete problems and Reduction techniques.**

Module 5

[6L]

Advanced Topics: Approximation beyond NP – **P SPACE algorithms, Randomized algorithms, Class of problems**

Suggested books:

1. Introduction to Algorithms, 4TH Edition, **Thomas H Cormen, Charles E Lieserson,** Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.

Suggested reference books

1. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
3. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA.

Course Name: Operating Systems
Course Code: PCC-CS403
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1

[7L]

Introduction: Concept of Operating Systems, **Generations of Operating systems, Types of Operating** Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.

Module 2

[9L]

Processes: Definition, Process Relationship, **Different states of a Process, Process State transitions,** Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time;

Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor Real Time scheduling: RM and EDF.

Module 3:

[7L]

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Module 4:

[9L]

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation –Fixed and variable partition– Internal and External fragmentation and Compaction;

Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

Module 5:

[8L]

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks

Text

Suggested books:

1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.

2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

Suggested reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
2. Operating Systems: A Modern Perspective, 2 nd Edition by Gary J. Nutt, Addison-Wesley
3. Design of the Unix Operating Systems, 8 th Edition by Maurice Bach, Prentice-Hall of India
4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

Course Name: Computer Organization and Architecture Lab
Course Code: PCC-CS491
Contact: 3P
Credits: 2
No. of Periods: 24

All laboratory assignments are based on Hardware Description Language (VHDL or Verilog) simulation.

Module 1
HDL introduction: Basic digital logic base programming with HDL, 8-bit Addition, Multiplication, Division

Module 2
Register & Memory: 8-bit Register design, Memory unit design and perform memory operations.

Module 3
CPU & ALU: 8-bit simple ALU design, 8-bit simple CPU design, Interfacing of CPU and Memory

Module 4
Assembly Language Programming-I: Study of Prewritten programs on 8085 trainer kit using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical). Addition, Subtraction, Multiplication, Division

Module 5
Assembly Language Programming-II: Shift, Rotate, BCD, ASCII, Conversion

Course Name: Design and Analysis of Algorithm Lab
Course Code: PCC-CS492
Contact: 3P
Credits: 2
No. of Periods: 24

Module 1

Divide and Conquer : Implement Binary Search **using Divide and Conquer approach, Implement** Quick Sort using Divide and Conquer approach, **Find Maximum and Minimum element from a array of integer**

Module 2

Greedy method: (implement any one of the **following problem) : Knapsack Problem, Job sequencing with** deadline, Minimum Cost Spanning **Tree by Prim's Algorithm, Minimum Cost Spanning Tree by Kruskal's** Algorithm

Module 3

Branch and Bound : Implement 15 **Puzzle Problem, Backtracking : Implement 8 Queen problem, (implement** any one of the following problem**): Graph Coloring Problem, Hamiltonian Problem**

Module 4

Dynamic Programming : Find the minimum **number of scalar multiplication needed for chain of matrix,** Implement all pair of Shortest path **for a graph (Floyed- Warshall Algorithm), Implement Traveling** Salesman Problem, Implement **Single Source shortest Path for a graph (Dijkstra , Bellman Ford** Algorithm)

Module 5

Graph Traversal Algorithm : Breadth First Search **(BFS), Depth First Search (DFS)**

Course Name: Operating System Lab
Course Code: PCC-CS493
Contact: 3P
Credits: 2
No. of Periods: 24

Module 1

Shell programming : creating a script, **making a script executable, shell syntax (variables, conditions,** control structures, functions, commands).

Module 2

Process : starting new process, replacing **a process image, duplicating a process image, waiting for a** process, zombie process.

Module 3

Signal: Signal handling, sending signals, **signal interface, signal sets.**

Module 4

Semaphore: programming with semaphores **(use functions semctl, semget, semop, set_semvalue,** del_semvalue, semaphore_p, semaphore_v).

Module 5

Inter-process communication: pipes(use **functions pipe, popen, pclose), named pipes(FIFOs,** accessing FIFO)

Course Name: Linux Administration Lab
Course Code: PCC-CS494
Contact: 2P
Credits: 1
No. of Periods: 16

Module 1

Introduction: Introduction to System Administration

Module 2

Tools: Essential Administrative Tools, Starting **and shutdown**

Module 3

Accounts: User Accounts, Security

Module 4

Network Management: TCP / IP Network **Management**

Module 5

Data Management: Linux Data Management, **POSIX Threads**

SEMESTER – V

Paper Code	Paper Name	L-T-P	Credits	Total Marks
HSMC(CSE)501	Management II	3-0-0	3	100
ESC(CSE)501	Signals and Systems	3-0-0	3	100
PCC-CS501	Database Management Systems	3-0-0	3	100
PCC-CS502	Object Oriented Programming	3-0-0	3	100
PCC-CS503	Formal Language and Automata Theory	3-0-0	3	100
PEC-501	Elective I A. Image Processing B. Software Engineering C. Artificial Intelligence	3-0-0	3	100
PCC-CS591	Database Management System Lab	0-0-3	2	100
PCC-CS592	Object Oriented Programming Lab	0-0-3	2	100

BRAINWARE UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure: B. Tech. Computer Science & Engineering 2018

MC-4	Constitution of India	1–0-0	0	0
	Total		22	800

Course Name: Database Management Systems
Course Code: PCC-CS501
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[8L]
Database system architecture: Data Abstraction, **Data Independence, Data Definition Language (DDL),** Data Manipulation Language (DML).
Data models: Entity-relationship model, **network model, relational and object oriented data models, integrity constraints,** data manipulation **operations.**

Module 2
[12L]
Relational query languages: Relational algebra, **Tuple and domain relational calculus, SQL3, DDL and** DML constructs, Open source and Commercial **DBMS - MYSQL, ORACLE, DB2, SQL server. Relational** database design: Domain and data dependency, **Armstrong's axioms, Normal forms, Dependency** reservation, Lossless design.
Query processing and optimization: Evaluation **of relational algebra expressions, Query equivalence,** Join strategies, Query optimization algorithms.

Module 3
[7L]
Storage strategies: Indices, B-trees, hashing.
Transaction processing: Concurrency control, **ACID property, Serializability of scheduling, Locking** and timestamp based schedulers, Multi-version **and optimistic Concurrency Control schemes,** Database recovery.

Module 4
[6L]
Database Security: Authentication, **Authorization and access control, DAC, MAC and RBAC models,** Intrusion detection, SQL injection.

Module 5
[7L]
Advanced topics: Object oriented and **object relational databases, Logical databases, Web** databases, Distributed databases, Data **warehousing and data mining.**

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Course Structure: B. Tech. Computer Science & Engineering 2018

Suggested books:

1. "Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.

Suggested reference books:

1 "Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.

2 "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education

3 "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

Course Name: Object Oriented Programming

Course Code: PCC-CS502

Contact: 2L

Credits: 3

No. of Lectures: 40

Module 1

[6L]

Object oriented concepts: Difference between **OOP and other conventional programming** – advantages and disadvantages. Class, **object, message passing, inheritance, encapsulation,** polymorphism

Module 2

[12L]

Class & Object properties: Basic concepts **of java programming – advantages of java, byte-code &** JVM, data types, access specifiers, operators, **control statements & loops, array, creation of class,** object, constructor, finalize and garbage collection, **use of method overloading, this keyword, use of** objects as parameter & methods returning **objects, call by value & call by reference, static variables** & methods, garbage collection, nested & inner **classes, basic string handling concepts- String (discuss** charAt() , compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring(), toCharArray() , toLowerCase(), toString(), toUpperCase() , trim() , valueOf() methods) & StringBuffer classes (discuss append(), capacity(), charAt(), delete(), deleteCharAt(), ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods), concept of mutable and immutable string, command line arguments, basics of I/O operations –keyboard input using BufferedReader & Scanner classes.

Module 3

[8L]

Reusability properties: Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, use of abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages.

Module 4

[7L]

Exception handling & Multithreading: Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes. Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication, deadlocks for threads, suspending & resuming threads.

Module 5

[7L]

Applet Programming: (using swing)- Basics of applet programming, applet life cycle, difference between application & applet programming, parameter passing in applets, concept of delegation event model and listener, I/O in applets, use of repaint(), getDocumentBase(), getCodeBase() methods, layout manager (basic concept), creation of buttons (JButton class only) & text fields.

Suggested books

1. Barbara Liskov, Program Development in Java, Addison-Wesley, 2001
2. R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING

Suggested reference books

1. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
2. Ivor Horton's Beginning Java 2 SDK – Wrox

Course Name: Formal Language and Automata Theory
Course Code: PCC-CS503
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1

[6L]

Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

Module 2

[9L]

Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata.

Module 3

[9L]

Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs.

Module 4

[6L]

Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.

Module 5

[10L]

Turing machines: The basic model for Turing machines (TM), Turing- recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable problems about languages.

Suggested books

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

Suggested reference books:

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
2. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
3. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
4. John Martin, Introduction to Languages and The Theory of Computation, Tata McGraw Hill.

Course Name: Image Processing
Course Code: PEC-501A

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure: B. Tech. Computer Science & Engineering 2018

Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[6L]

Introduction: Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.

Module 2
[10L]

Digital Image Formation: A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.

Mathematical Preliminaries: Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform.

Module 3
[8L]

Image Enhancement: Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.

Module 4
[7L]

Image Restoration: Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.

Module 5
[9L]

Image Segmentation: Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection - Local Processing, Global Processing via The Hough Transform; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.

Suggested books

1. Digital Image Processing, Gonzalves,Pearson
2. Digital Image Processing, Jahne, Springer India

Suggested reference books

1. Digital Image Processing & Analysis,Chanda & Majumder,PHI
2.Fundamentals of Digital Image Processing, Jain, PHI
3. Image Processing, Analysis & Machine Vision, Sonka, VIKAS

Course Name: Software Engineering
Course Code: PEC-501B
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[8L]
Software Engineering: Objectives, Definitions ,Software Process models - Waterfall Model, Prototype
model, RAD, Evolutionary Models ,Incremental, Spiral, Software Project Planning- Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model.

Module 2
[8L]
Structured Analysis: , Context diagram and DFD, Physical and Logical DFDs ,Data Modelling, ER diagrams, Software Requirements Specification

Module 3
[10L]
Design Aspects : Top-Down And Bottom-Up design; Decision tree, decision table and structured English, Structure chart, Transform analysis Functional vs. Object- Oriented approach.
Unified Modelling Language: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, Implementation diagram.

Module 4
[7L]
Coding & Documentation: Structured Programming, Modular Programming, Module Relationship-Coupling, Cohesion, OO Programming, Information Hiding, Reuse, System Documentation.

Module 5
[7L]

Testing: Levels of Testing, Integration Testing, System Testing, Software Quality, Quality Assurance, Software Maintenance, Software Configuration Management, Software Architecture.

Suggested books

1. Software Engineering : A practitioner's approach– Pressman(TMH)
2. Software Engineering- Rajib Mall (PHI)

Suggested reference books

1. Software Engineering- Pankaj Jalote (Wiley-India)
2. Software Engineering –Agarwal and Agarwal (PHI)

Course Name: Artificial Intelligence
Course Code: PEC-501C
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[6L]

Introduction: Overview of Artificial Intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.

Module 2
[5L]

Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

Module 3
[12L]

Search techniques: Solving problems by searching :problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies, Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfa
ction problems, local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

Module 4
[10L]

Knowledge & reasoning: Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation. Using predicate logic, Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural versus declarative knowledge, logic programming, forward versus backward reasoning, matching, control knowledge. Probabilistic reasoning, Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.

Module 5
[7L]

Planning: Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques.

Natural Language processing: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.

Learning: Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning.

Expert Systems: Representing and using domain knowledge, expert system shells, knowledge acquisition.

Suggested books

1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel, Peter Norvig Pearson

Suggested reference books

1. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
2. Poole, Computational Intelligence, OUP

Course Name: Database Management Systems Lab
Course Code: PCC-CS591
Contact: 3P
Credits: 2
No. of Periods: 24

Module 1
Creating Database
Creating a Database
Creating a Table
Specifying Relational Data Types
Specifying Constraints

Creating Indices

Module 2
Table and Record Handling
INSERT statement
Using SELECT and INSERT together
DELETE, UPDATE, TRUNCATE statements
DROP, ALTER statements

Module 3
Retrieving Data from a Database
The SELECT statement
Using the WHERE clause
Using Logical Operators in the WHERE clause
Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause
Using Aggregate Functions
Combining Tables Using JOINS Subqueries

Module 4
Database Management
Creating Views
Creating Column Aliases
Creating Database Users
Using GRANT and REVOKE

Module 5
PL/SQL
Cursors in Oracle PL / SQL
Writing Oracle PL / SQL Stored Procedures

Course Name: Object Oriented Programming Lab
Course Code: PCC-CS592
Contact: 3P
Credits: 2
No. of Periods: 24

Module 1
OOP Basics:
Class
Constructor
Overloading

Inheritance
Overriding
Wrapper class
Arrays

Module 2
Developing interfaces:
Multiple inheritance
Extending interfaces

Module 3
Packages:
Creating packages
Accessing packages

Module 4
Multithreaded Programming

Module 5
Applet programming

SEMESTER – VI

Paper Code	Paper Name	L-T-P	Credits	Total Marks
PCC-CS601	Compiler Design	3-0-0	3	100
PCC-CS602	Computer Networks	3-0-0	3	100
PEC-601	Elective II A. Advanced Algorithms B. Distributed Systems C. Machine Learning	3-0-0	3	100
PEC-602	Elective III A. Cloud Computing B. Embedded Systems C. Data Mining	3-0-0	3	100
OEC-601	Open Elective I (Humanities) A. Entrepreneurship B. Project Management C. Soft Skills and Interpersonal Communication D. Human Resource Development	3-0-0	3	100
PCC-CS691	Compiler Design Lab	0-0-3	2	100
PCC-CS692	Computer Networks Lab	0-0-3	2	100
PROJ-CS681	Project I	0-0-6	4	100

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Course Structure: B. Tech. Computer Science & Engineering 2018

CS682	Seminar I	0 – 0 - 2	1	100
Total			**24**	**900**

Course Name: Compiler Design
Course Code: PCC-CS601
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[2L]
Introduction: Phases of compilation and overview.

Module 2
[8L]
Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, from regular expressions to finite automata, scanner generator (lex, flex).

Module 3
[10L]
Syntax Analysis (Parser): Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)

Module 4
[12L]
Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree.
Symbol Table: Structure, symbol attributes and management.
Run-time environment: Procedure activation, parameter passing, value return, memory allocation, and scope.
Intermediate Code Generation: Translation of different language features, different types of intermediate forms.
Code Improvement (optimization): Analysis: control-flow, data-flow dependence etc.; Code improvement local optimization, global optimization, loop optimization, peep-hole optimization etc.

Module 5
[8L]
Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation

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Course Structure: B. Tech. Computer Science & Engineering 2018

Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

Course Name: Computer Networks
Course Code: PCC-CS602
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[8L]

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media,
LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN
Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Module 2
[9L]

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

Module 3
[7L]

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Module 4
[9L]

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service
QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Module 5
[7L]

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

Suggested books

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Course Structure: B. Tech. Computer Science & Engineering 2018

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.

Suggested reference books

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

Course Name: Advanced Algorithms
Course Code: PEC601A
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[10L]
Design Paradigms: Overview of Divide and Conquer, Greedy and Dynamic Programming strategies. Basic search and traversal techniques for graphs, Backtracking, Branch and Bound. Max Flow Problem

Module 2
[8L]
String Matching: Introduction to string-matching problem, Naïve algorithm, Rabin Karp, Knuth Morris Pratt, Boyer-Moore algorithms and complexity analysis.

Module 3
[7L]
Complexity: P, NP and NP-Complete complexity classes; A few NP-Completeness proofs; Other complexity classes. Theory of NP- Hard and NP-Complete Problems.

Module 4
[8L]
Approximation Algorithms: Introduction, Combinatorial Optimization, approximation factor, PTAS, FPTAS, Approximation algorithms for vertex cover, set cover, TSP, knapsack, bin packing, subset-sum problem etc. Analysis of the expected time complexity of the algorithms.

Module 5
[7L]
Parallel Algorithms: Introduction, Models, speedup and efficiency, Some basic techniques, Examples from graph theory, sorting, Parallel sorting networks. Parallel algorithms and their parallel time and processors complexity.

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Course Structure: B. Tech. Computer Science & Engineering 2018

Suggested books

1. The Algorithm Design Manual, Steven S. Skiena, Springer 2011
2. Algorithms, 4th Edition, Robert Sedgewick, Kevin Wayne Wiley, 2011

Suggested reference books

1. Algorithms Unlocked, Thomas H Cormen, MIT Press, 2013

Course Name: Distributed Systems
Course Code: PEC601B
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[4L]
Introduction to Distributed System: Introduction, Examples of distributed system, Resource sharing, Challenges

Module 2
[8L]
Operating System Structures: Review of structures: monolithic kernel, layered systems, virtual machines. Process based models and client server architecture; The micro-kernel based client-server approach.

Module 3
[10L]
Communication: Inter-process communication , Remote Procedure Call, Remote Object Invocation, Tasks and Threads. Examples from LINUX, Solaris 2 and Windows NT. Inherent Limitations of distributed Systems. Lamport's Logical clock. Global State Distributed Mutual Exclusion, Classification of distributed mutual exclusion algorithm. NonToken based Algorithm:Lamport's algorithm, Ricart-Agrawala algorithm. Token based Algorithm: Suzuki-Kasami's broadcast algorithm.

Module 4
[12L]
Distributed Deadlock Detection: Deadlock handling strategies in distributed systems. Control organizations for distributed deadlock detection. Centralized and Distributed deadlock detection algorithms: Completely Centralized algorithms, path pushing, edge chasing, global state detection algorithm.

Protection and Security: Requirements for protection and security regimes. The access matrix model of protection. System and user modes, rings of protection, access lists, capabilities. User authentication, passwords and signatures. Use of single key and public key encryption.

Module 5
[6L]

Distributed file systems: Issues in the design of distributed file systems: naming, transparency, update semantics and fault resilience. Use of the Virtual File System layer. Examples of distributed systems including Sun NFS, the Andrew filestore, CODA file system and OSF DCE.
Distributed Shared Memory: Architecture and motivations. Algorithms for implementing DSM. Memory Coherence

Suggested books

1. Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems Principles and Paradigms, PHI
2. Singhal Mukesh & Shivaratri N. G., Advanced Concepts in Operating Systems, TMH

Suggested reference books

1. Bacon, J., Concurrent Systems, 2nd Edition, Addison Wesley 1998.
2. Galli, D.L., Distributed Operating Systems: Concepts and Practice Prentice-Hall

Course Name: Machine Learning
Course Code: PEC601C
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[10L]

Introduction: Introduction to Machine Learning, Examples of Machine Learning applications - Learning associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning. Supervised learning- Input representation, Hypothesis class, Version space, Vapnik-Chervonenkis (VC) Dimension, Probably Approximately Learning (PAC), Noise, Learning Multiple classes, Model Selection and Generalization, Dimensionality reduction- Subset selection, Principal Component Analysis ·

Module 2
[8L]

Classification: Cross validation and re-sampling methods- K-fold cross validation, Bootstrapping, Measuring classifier performance- Precision, recall, ROC curves. Bayes Theorem, Bayesian classifier, Maximum Likelihood estimation, Density functions, Regression

Module 3
[9L]
Decision Trees: Entropy, Information Gain, Tree construction, ID3, Issues in Decision Tree learning- Avoiding Over-fitting, Reduced Error Pruning, The problem of Missing Attributes, Gain Ratio, Classification by Regression (CART), Neural Networks- The Perceptron, Activation Functions, Training Feed Forward Network by Back Propagation.

Module 4
[7L]
Kernel Machines: Support Vector Machine- Optimal Separating hyper plane, Soft-margin hyperplane, Kernel trick, Kernel functions. Discrete Markov Processes, Hidden Markov models, Three basic problems of HMMs- Evaluation problem, finding state sequence, Learning model parameters. Combining multiple learners, Ways to achieve diversity, Model combination schemes, Voting, Bagging, Booting

Module 5
[6L]
Unsupervised Learning: Clustering Methods - K-means, Expectation-Maximization Algorithm, Hierarchical Clustering Methods, Density based clustering

Suggested books
1. Mitchell. T, Machine Learning, McGraw Hill.
2. Ryszard S. Michalski, Jaime G. Carbonell, and Tom M. Mitchell, Machine Learning : An Artificial Intelligence Approach, Tioga Publishing Company.

Suggested reference books
1. Ethem Alpaydın, Introduction to Machine Learning (Adaptive Computation and Machine Learning), MIT Press, 2004.
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

Course Name: Compiler Design Lab
Course Code: PCC-CS691
Contact: 3P
Credits: 2
No. of Periods: 24

Module 1
Lexical Analyzer

Module 2
Grammer

Module 3
Parser

Module 4
Loop unrolling

Module 5
YACC

Course Name: Computer Networks
Course Code: PCC-CS602
Contact: 3P
Credits: 2
No. of Periods: 24

Module 1
NIC Installation & Configuration (Windows/Linux)

Module 2
Familiarization
Networking cables (CAT5, UTP)
Connectors (RJ45, T-connector)
Hubs, Switches
IPC (Message queue)

Module 3
Socket Programming
TCP/UDP Socket Programming
Multicast & Broadcast Sockets
Implementation of a Prototype Multithreaded Server

Module 4
Flow control
Implementation of Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window)

Module 5
Error Detection and Correction
Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N)

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure: B. Tech. Computer Science & Engineering 2018

SEMESTER – VII

Paper Code	Paper Name	L - T - P	Credits	Total Marks
BSC(CSE)701	Biology	1 – 1 – 0	2	100
PEC-701	Elective IV A. Big Data Analysis B. Cloud Security	3 - 0 – 0	3	100
PEC-702	Elective V MOOC Courses	3 - 0 – 0	3	100
OEC-701	Open Elective II A. Analog Communication B. Digital Communication C. Cyber Law and Ethics D. Indian Music System	3 - 0 – 0	3	100
PROJ-CS781	Project II (Industrial Training)	0 – 0 – 8	4	100
CS782	Seminar II	0 – 0 - 2	1	100
	Total		17	600

Course Name: Big Data Analysis
Course Code: PEC701A
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1

[10L]

Introduction: Evolution of Big data – Best Practices for Big data Analytics – Big data characteristics – Validating – The Promotion of the Value of Big Data – Big Data Use Cases- Characteristics of Big Data Applications – Perception and Quantification of Value -Understanding Big Data Storage – A General Overview of High-Performance Architecture – HDFS – MapReduce and YARN – Map Reduce Programming Model

Module 2

[8L]

Clustering and Classification: Overview of Clustering – K-means – Use Cases – Overview of the Method – Determining the Number of Clusters – Diagnostics – Reasons to Choose and Cautions .- Classification: Decision Trees – Overview of a Decision Tree – The General Algorithm – Decision Tree Algorithms – Evaluating a Decision Tree – Decision Trees in R – Naïve Bayes – Bayes' Theorem – Naïve Bayes Classifier.

Module 3

[8L]

Association and Recommendation System: Association Rules – Overview – Apriori Algorithm – Evaluation of Candidate Rules – Applications of Association Rules – Finding Association & finding similarity – Recommendation System: Collaborative Recommendation- Content Based Recommendation – Knowledge Based Recommendation- Hybrid Recommendation Approaches.

Module 4

[8L]

Stream Memory: Streams Concepts – Stream Data Model and Architecture – Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) applications – Case Studies – Real Time Sentiment Analysis, Stock Market Predictions. Using Graph Analytics for Big Data: Graph Analytics

Module 5

[6L]

NoSQL Data Management for Big Data and Visualization: NoSQL Databases - Schema-less Models, Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores – Tabular Stores – Object Data Stores – Graph Databases Hive – Sharding — Hbase – Analyzing big data with twitter – Big data for E-Commerce Big data for blogs – Review of Basic Data Analytic Methods using R.

Suggested books

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, 2013.

Suggested reference books

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
3. Dietmar Jannach and Markus Zanker, "Recommender Systems: An Introduction", Cambridge University Press, 2010.

Course Name: Cloud Security
Course Code: PEC701B
Contact: 3L
Credits: 3
No. of Lectures: 40

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Course Structure: B. Tech. Computer Science & Engineering 2018

Module 1

[8L]

Introduction: Cloud, Services provided by cloud - Software As a Service(SaaS), Infrastructure As a Service(IaaS), Platform As a Service(PaaS), Desktop As a Service (DaaS) and VDI etc. Advantages & Disadvantages, Applications for Businesses Cloud Service Providers; Brief overview of major Cloud Service providers – Amazon AWS, Google App Engine, Microsoft, VMware. Cloud Computing Risks and Issues

Module 2

[7L]

Virtualization: Virtualization concepts, Objectives, Types of Virtualization & its benefits, Introduction to Various Virtualization OS (Hypervisor), HA/DR using Virtualization, Live Migration of VMs, SAN backend concepts, S/W defined Networking (OpenFlow/OpenVSwitch), S/W Defined Datacenter, S/W Defined Storages. Virtualization for Enterprise - Vmware, Xen, KVM with oVirt, Hyper-V

Module 3

[9L]

Building Cloud Networks: Designing and Implementing a Data Center-Based Cloud, Industry and International Standards Communication Requirements for Cloud Implementation Private , Public & Hybrid Clouds, Private, Public & Hybrid Clouds - Advantages & Disadvantages, On Premises and Off Premises Cloud services, installing a Cloud service using Eucalyptus, Open Nebula, Open Stack, Amazon Web Services, Microsoft Azure, Google App Engine, VMware air, Setting up your own Cloud

Module 4

[7L]

Private Cloud: Private cloud using open source tools, Understanding various cloud plugins, Setting up your own cloud environment, Autoprovisioning, Custom images, Integrating tools like Nagios Integration of Public and Private Cloud

Module 5

[9L]

Cloud Security Services: Infrastructure Security, Network level security, Host level security, Application level security, Data security and Storage, Data privacy and security Issues, Jurisdictional issues raised by Data location, Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations

Suggested books

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

2. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.

Suggested reference books

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

SEMESTER – VIII

Paper Code	Paper Name	L-T-P	Credits	Total Marks
PEC801	Elective VI A. Security and Privacy of Data B. Modelling Internet Attack	3-0-0	3	100
OEC-801	Open Elective III MOOC Courses	3-0-0	3	100
OEC-802	Open Elective IV A. Fiber optic Communication B. Satellite Communication C. History of Science D. Organizational Behavior	3-0-0	3	100
PROJ-CS881	Project III	0-0-8	4	100
CS882	Grand Viva	0-0-0	1	100
	Total		**13**	**500**

Total Credit: 160

Course Name: Security and Privacy of Data
Course Code: PEC801A
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1
[6L]

Secure Isolation of Physical & Logical Infrastructure: Objectives, Isolation, Readings Compute, Network and Storage, Common attack vectors and threats, Secure Isolation Strategies

Module 2

[5L]

Multitenancy, Virtualization strategies: Inter-tenant network segmentation strategies, Storage isolation strategies

Module 3

[9L]

Data Protection for Cloud Infrastructure and Services: Cloud based Information Life Cycle, Data protection for Confidentiality and Integrity, Common attack vectors and threats, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key Management, Assuring data deletion, Data retention, deletion and archiving procedures for tenant data, Data Protection Strategies

Module 4

[11L]

Enforcing Access Control for Cloud Infrastructure based Services: Access control requirements for Cloud infrastructure, Common attack vectors and threats, Enforcing Access Control Strategies Compute, Network and Storage, Authentication and Authorization, Roles-based Access Control, Multi-factor authentication, Host, storage and network access control options, OS Hardening and minimization, securing remote access, Verified and measured boot Readings, Firewalls, IDS, IPS and honeypots

Module 5

[9L]

Monitoring, Auditing and Management: Proactive activity monitoring, Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges, intrusion detection, events and alerts, Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management

Suggested books

1. John R. Vacca, "Cloud Computing Security", CRC Press 2016.
2. Shahed Latif, Subra Kumaraswamy, Tim Mather, "Cloud Security and Privacy" O'Reilly 2009

Suggested reference books

1. Pearson, Siani, Yee, George (Eds.) "Privacy and Security for Cloud Computing" Springer 2013
2. Imad M. Abbadi, "Cloud Management and Security" Wiley

Course Name: Modeling Internet Attack
Course Code: PEC801B
Contact: 3L
Credits: 3

BRAINWARE UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure: B. Tech. Computer Science & Engineering 2018

No. of Lectures: 40

Module 1

[8L]

Introduction: Network Security Model, Types of Attack, Overview of Most Common Security Issues, Linux Security Overview, Password Attack, Dictionary Attack - Thwarting dictionary attack, IP Tables, Using iptables to thwart dictionary attack, Password Cracking -

Module 2

[5L]

Hashing: Overview, Lookup tables, Introduction to Rainbow Table, Modern Linux Password Hashing Scheme

Module 3

[7L]

Malware: Virus Infection Techniques, Anatomy of a Virus, Virus Propagation, Classification of Viruses based on Infection Techniques, Memory Strategies etc., Defense Against Viruses, Worms, (Case Study Morris Worm & Conficker worm), Malware analysis, Static and Dynamic Malware analysis

Module 4

[10L]

Application Vulnerabilities: Smashing the Stack for Fun and Profit, Format string attack, SQL Injection, XSS, Authentication- Overview of Authentication, Need for Key Distribution Centers, Authentication & Key Distribution Protocols - Needham Schroeder, Kerberos, Random Number Generation - Psuedo and True random number generators, Cryptographically Secure PRNGs – The Blum BlumShub Generator, PRNG – Linear Congruential Generators, Entropy - software and hardware, Message Authentication Codes

Module 5

[10L]

TCP/IP Vulnerabilities: TCP Overview - Connection Setup/Teardown, Packet Sniffing, Detecting Sniffers on your network, IP Spoofing, ARP Poisoning, UDP Hijacking, Fragmentation Attack- Ping of Death, Evasion & Denial of Service, UDP Hijacking, TCP Spoofing, TCP Hijacking - Mitnick attack, Joncheray attack, SYN Flood Attack, Denial of Service Attack, Port Scanning Techniques DNS – DNS Zones, Zone Transfer, BIND, DNS Spoofing, DNS Cache Poisoning, IPSec –Introduction, Tunnel & Transfer Modes, IPSec Authentication Header, Encapsulating Security Header and Payload, IPSec Key Exchange

Suggested books

1. Charlie Kaufman, Radia Perlman and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Second Edition, Prentice Hall, 2002.

2. Eric Rescoria, "SSL and TLS : Designing and Building Secure Systems", Addison-Wesley Professional, 2000.

Suggested reference books

1. Stephen Kent, Charles Lynn, Joanne Mikkelson, and Karen Seo, Secure Border Gateway Protocol (S-BGP)-Real World Performance and Deployment Issues, NDSS, 2000.
2. Proctor Paul, The Practical Intrusion Detection Handbook, Third Edition, Prentice-Hall, Englewood Cliffs

N. B. A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

The said course is however optional and the student is entitled to acquire such credits during the entire period of study.

Course Name: Cloud Computing
Course Code: PCC-CS602A
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1 I: Introduction **[4L]**
Introduction to Cloud Computing, Migrating into a Cloud, Enriching the 'Integration as a Service' Paradigm for the Cloud Era. The Enterprise Cloud Computing Paradigm.

Module 2: Systems Modeling, Clustering and Virtualization **[6L]**
Distributed System Models and Enabling Technologies. Computer Clusters for Scalable Parallel Computing. Virtual Machines and Virtualization of Clusters and Data centres. Applications of such modular architecture.

Module 3: Cloud Platform Architecture **[8L]**
Cloud Computing and service Models, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms, Inter Cloud Resource Management, Cloud Security and Trust Management. Service Oriented Architecture (SOA

Module 4: Cloud Programming and Software Environments **[8L]**
Features of Cloud and Grid Platforms, Parallel & Distributed Programming Paradigms, Programming Support of Google App Engine, ProgrammS and Microsoft Azure, Emerging Cloud Software Environments

Module 5: Cloud Resource Management and Scheduling **[14L]**
Policies and Mechanisms for Resource Management Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Evolution of storage technology, storage models, file systems and databases, distributed file systems, general parallel file systems. Google file system, Apache Hadoop, BigTable, Megastore, Amazon Simple Storage Service (S3).

Suggested books:

1. Cloud Computing bible,Sosinsky, Barrie ,Wiley
2. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.
3. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH

Suggested reference books

1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011
2. Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010

Course Name: Embedded Systems
Course Code: PCC-CS602B
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1 : Fundamentals of Embedded System **[8L]**
Core of the embedded system, Memory, Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers), Communication Interface, Embedded firmware (RTOS, Drivers, Application programs), Power-supply (Battery technology, Solar), PCB and Passive components, Safety and reliability, environmental issues. Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency Embedded Product development life cycle, Program modeling concepts: DFG, FSM, Petri-net, UML

Module 2: Embedded Serial Communication **[6L]**
Study of basic communication protocols like SPI, SCI (RS232, RS485), I2C, CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig-Bee, Wireless sensor network

Module 3: Embedded Software, Firmware Concepts and Design **[8L]**
Embedded C - programming concepts (from embedded system point of view): Optimizing forSpeed/Memory needs, Interrupt service routines, macros, functions, modifiers, data types, device drivers, Multithreading programming.Real time operating system: POSIX Compliance , Need of RTOS in Embedded system software, Foreground/Background systems, multitasking, context switching, IPC, Scheduler policies, Architecture of kernel, task scheduler, ISR, Semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS.

Module 4: Embedded Hardware and Design **[8L]**
Introduction to ARM - v7-M (Cortex-M3), ARM -v7-R(CortexR4) and comparison in between them

Module 5: µCOS **[10L]**
Introduction to µCOS-II RTOS, study of kernel structure of µCOS-II, Synchronization in µCOS-II, Inter-task communication in µCOS-II, Memory management in µCOS-II, porting of RTOS on ARM -v7 (emulation) board, Application developments using µCOS-II.

Suggested books:
1. Introduction to Embedded Systems : Shibu K. V. (TMH)
2. Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley)
3. Embedded Systems : Rajkamal (TMH)
4. Embedded Systems : L. B. Das (Pearson)

Suggested reference books
1. Embedded System design : S. Heath (Elsevier)
2. Embedded microcontroller and processor design: G. Osborn (Pearson)
3. Embedded Systems: Frank Vahid , Wiley India, 2002
4. Embedded Microcomputer Systems – Real Time Interfacing – Jonathan W. Valvano; Cengage Learning; Third edition.

AD

Course Name: Data Mining
Course Code: PCC-CS602C
Contact: 3L
Credits: 3
No. of Lectures: 40

Module 1 : Introduction to Data Mining **[8L]**
Data mining - Related technologies - Machine Learning, DBMS, OLAP, Statistics, Data Mining Goals, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Applications, Example: weather data

Module 2: Data Warehouse and OLAP **[6L]**
Data Warehouse and DBMS, Multidimensional data model, OLAP operations, Example: loan data set

Module 3: Data preprocessing **[8L]**
Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies, Installing Weka 3 Data Mining System, Experiments with Weka - filters, discretization

Module 4: Data mining knowledge representation **[8L]**
Task relevant data, Background knowledge, Interestingness measures, Representing input data and output knowledge, Visualization techniques

Module 5: Clustering **[10L]**
Basic issues in clustering, First conceptual clustering system: Cluster/2, Partitioning methods: k-means, expectation maximization (EM), Hierarchical methods: distance-based agglomerative and divisible clustering, Conceptual clustering: Cobweb, Experiments with Weka - k-means, EM, Cobweb

Suggested books:
1. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques (Second Edition), Morgan Kaufmann, 2005

Suggested reference books:
1. Principles of Data Mining (D. Hand, H. Mannila, and P. Smyth, MIT Press, 2001)
2. T. Hastie, R. Tibshirani, and J. Friedman (2001) The Elements of Statistical Learning: data mining, inference and prediction. Springer Verlag

Course Name: Digital Communication

Course Code: OEC-701B

Contact: 3L

Credits: 3

No. of Lectures: 40

Module 1: Sampling & Quantization **[10L]**

Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Logarithmic Companding of speech signal- PCM - TDM.

Module 2: Waveform Coding **[6L]**

Prediction filtering and DPCM - Delta Modulation - ADPCM & ADM principles-Linear Predictive Coding

Module 3: Baseband Transmission **[10L]**

Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ – Bipolar NRZ - Manchester- ISI – Nyquist criterion for distortionless transmission – Pulse shaping – Correlative coding - Mary schemes – Eye pattern - Equalization.

Module 4: Digital Modulation Scheme **[6L]**

Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK - QAM - Carrier Synchronization - structure of Non-coherent Receivers - Principle of DPSK.

Module 5: Error Control Coding **[8L]**

Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Vitterbi Decoder.

Suggested books:

1. S. Haykin, "Digital Communications", John Wiley, 2005

Suggested reference books:

1. B. Sklar, "Digital Communication Fundamentals and Applications", 2nd Edition, Pearson Education, 2009
2. B.P.Lathi, "Modern Digital and Analog Communication Systems" 3rd Edition, Oxford University Press 2007.
3. H P Hsu, Schaum Outline Series – "Analog and Digital Communications", TMH 2006 4. J.G Proakis, "Digital Communication", 4th Edition, Tata Mc Graw Hill Company, 2001.

Course Name: Cyber Law and Ethics

Course Code: OEC-701C

Contact: 3L

Credits: 3

No. of Lectures: 40

Module 1: Introduction **[10L]**

Computers and its Impact in Society, Overview of Computer and Web Technology, Need for Cyber Law, Cyber Jurisprudence at International and Indian Level

Module 2: Cyber Law - International Perspectives **[10L]**

UN & International Telecommunication Union (ITU) Initiatives, Council of Europe - Budapest Convention on Cybercrime, Asia-Pacific Economic Cooperation (APEC), Organization for Economic Co-operation and Development (OECD), World Bank, Commonwealth of Nations

Module 3: Constitutional & Human Rights Issues in Cyberspace **[6L]**

Freedom of Speech and Expression in Cyberspace, Right to Access Cyberspace – Access to Internet, Right to Privacy, Right to Data Protection

Module 4: Cyber Crimes & Legal Framework **[10L]**

Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber Pornography, Identity Theft & Fraud, Cyber terrorism, Cyber Defamation, Different offences under IT Act, 2000

Module 5: Cyber Torts **[4L]**

Cyber Defamation, Different Types of Civil Wrongs under the IT Act, 2000

Suggested books:

1. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
2. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).
3. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)
4. Jonthan Rosenoer, Cyber Law , Springer, New York, (1997).
5. Sudhir Naib, The Information Technology Act, 2005: A Handbook, OUP, New York, (2011)

Suggested reference books:

1.Hon C Graff, Cryptography and E-Commerce - A Wiley Tech Brief, Wiley Computer Publisher, 2001
2.Michael Cross, Norris L Johnson, Tony Piltzecker, Security, Shroff Publishers and Distributors Ltd.

2017.

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SEMESTER – IV

Paper Code	Paper Name	L - T - P	Credits	Total Marks
BCSE401	Design and Analysis of Algorithm	3 - 1 – 0	4	100
BCSE402	Object Oriented System	3 - 1– 0	4	100
BCSE403	Computer Graphics	3- 1 – 0	4	100
BCSE404	Formal Language and Automata	3- 1 – 0	4	100
HU492	Communicative English IV Lab	0 – 0 - 3	2	100
BCSE491	Algorithms with Python Lab	0 – 0 - 3	3	100
BCSE492	Object Oriented System with Java Lab	0 – 0 – 3	3	100
BCSE493	Computer Graphics Lab	0 – 0 – 3	3	100
BCSE494	Modern Application Development Lab-I	0 – 0 – 3	3	100
	Total		30	900

Paper Name: Design and Analysis of Algorithm
Paper Code: BCSE401
Contact: 3L+1T
Credits: 4
No. of Lectures: 40

36L

Unit I: Introduction to Algorithm **[1L]**
RAM model of computation; Definition of algorithm; Basic characteristics, types and design techniques.

Unit II: Complexity Analysis
[3L]
Time and Space Complexity, Different Asymptotic notations (BigO, Ω, Θ and small o, ω) – their mathematical significance; Lower Bound Theory: O(nlgn) bound for Comparison sort.

Unit III: Recurrence: **[2L]**
Recursion and Iterartion – comparison; Tail recursion; Recurrence relations and finding solutions through telescoping,Tree recursion, Master Theorem; Range and Domain transformation with examples: Fibonacci recurrence, Tower of Hanoi.

Unit IV: Sorting Algorithms:
[4L]

Merge sort, Quick sort with Divide and Conquer approach, their complexity analysis; Heap sort and it's complexity.

Unit V: Graph traversal algorithm **[1L]**

Breadth First Search(BFS) and Depth First Search(DFS); Classification of edges - tree, forward, back and cross edges – complexity and comparison.

Unit IV: Algorithm Design by Greedy Strategy **[3L]** [4L]

Basic concept of Greedy strategy; Fractional Knapsack problem; Job sequencing with deadline. Graph Algorithms: Minimum spanning tree by Prim's, Kruskal's algorithm. Single source shortest path - Dijkstra's algorithm.

Unit V: Algorithm Design by Dynamic Programming

[4L]

Basic method of Dynamic programming; use; Matrix Chain Multiplication, All pair shortest paths - Floyd Warshall Algorithm, Single source shortest path - Bellman Ford Algorithm.

Unit VII: Algorithm Design by Backtracking

[2L]

Basic concept of Backtracking; N-Queen Problem, Graph Coloring Problem, Hamiltonian Path Problem.

Unit IX: Algorithm Design by Branch and Bound

[2L]

0/1 knapsack problem, Integer programming.

Unit VIII: String Matching Problem

[2L]

Different techniques - Naive Algorithm, Knuth Morris Pratt (KMP) Algorithm and their complexity.

Unit IX: Network Flow

[2L]

Ford Fulkerson algorithm, Max-Flow Min-Cut theorem (Statement and Illustration).

Unit X: Amortized Analysis

[2L]

Aggregate, Accounting, and Potential Method; Comparison with asymptotic analysis.

Unit XI: Notion of NP-completeness

[4L]

P class, NP class, NP hard class, NP complete class – their interrelationship, Satisfiability problem, Cook's theorem (Statement only), Clique decision problem.

Unit XI: Approximation Algorithm **[3L]**

Necessity of approximation scheme, performance guarantee, polynomial time approximation schemes, vertex cover problem, travelling salesman problem.

Unit XII: Fourier Transform **[1L]**

Discrete Fourier Transform(DFT) and Fast Fourier Transform(FFT)[concept only].

Suggested books:

1. *Cormen, Thomas H.; Leiserson, Charles E.; Rivest, Ronald L.; Stein, Clifford (2009) [1990]. Introduction to Algorithms (3rd ed.). MIT Press and McGraw-Hill*
2. A. V. Aho, J. E. Hopcroft, J. D. Ullman, *The Design and Analysis of Computer Algorithms.* Addison-Wesley, 1974.
3. D.E.Knuth; *The Art of Computer Programming, Volumes 1-4A Boxed Set.* Third Edition (Reading, Massachusetts: Addison-Wesley, 2011), 3168pp. "The Art of Computer Programming", Vol. 3
4. E.Horowitz and Shani; *Fundamentals of Computer Algorithms*; Computer Science Press, division of W.H. Freeman, New York 1984.

Paper Name: Object Oriented System
Paper Code: BCSE402
Contact: 3L+1T
Credits: 4
No. of Lectures: 40

Unit I: Introduction
[2L]

Introduction- Object oriented concept, difference between procedure oriented and object oriented approach. Advantages of object oriented approach, programming languages that supports OOP.

Unit II: Basics of OOP **[5L]**

Properties of Object oriented programming. ADT, Class and Object concepts. Members and accesibility scope of members of a class.shared and non-shared members of class and their usage, inner class.

Unit III: Polymorphism
[7L]

Abstraction, Encapsulation and Data hiding. Concept of object initialization- general idea of constructor. static vs run time polymorphism. Advantage of polymorphism. Destruction of objects, garbage collection concept. Cohesion and coupling.

Unit IV: Inheritance
[7L]

Inheritance- concept of inheritance, types of inheritance- single, multiple, multilevel and hybrid. overloading vs overriding. Consequence of multiple inheritance. Generalization and specialization.

Unit V: Exception Handling and Multithreading (using Java)
[6L]

Exception handling & Multi threading – Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes.Basics of multi-threading, main thread, thread life cycle, creation of multiple threads

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Unit VI: Handling data structures with Collection framework (Java)
[3L]
Introduction to java Collection Framework. Components of Collection framework. Introduction to ArrayList, Vector, List, Map, HashMap, Set, HashSet and their application areas.

Unit VII: Database Connectivity with Java
[4L]
Introduction to JDBC,JDBC Drivers & Architecture, CURD operation Using JDBC

Unit VIII: UML basics
[2L]
Introduction and usage of UML diagrams: Class diagram, Activity diagram to practice. Case study.

Suggested books:

1. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" - TMH
2. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH
3. Rambaugh, James Michael, Blaha - "Object Oriented Modelling and Design" - Prentice Hall India/ Pearson Education

Paper Name: Computer Graphics
Paper Code: BCSE403
Contact: 3L+1T
Credits: 4
No. of Lectures: 40

Unit I: Introduction
[3L]
Video Display Devices, CRT, LCD display devices Raster-Scan and Random-Scan Systems, Graphics Monitors and Workstations, Input devices, keyboard, mouse, trackball, data glove, scanners and Hard Copy Devices, Graphics Software.

Unit II: Output Primitives
[8L]
Line Drawing algorithms (DDA and Bresenham's line drawing algorithm), Circle Generating Algorithms (Bresenham's and midpoint circle drawing algorithm), Ellipse Generating Algorithms (midpoint ellipse drawing algorithm), Other curves, Antialiasing and filtering techniques, Filled area primitives.

Unit III: Two Dimensional geometric transformations
[9L]
Basic transformations (translation, rotation, scaling), Matrix representations and Homogeneous Coordinates, Composite transformations, other transformations, Affine transformation, Transformation between coordinate systems, Two Dimensional Viewing, Window - to - viewport Coordinate transformation.

Unit IV: Clipping operations
[4L]
Line clipping (Cohen - Sutherland algorithm), clip windows, polygon clipping with Sutherland Hodgeman algorithm.

Unit V: Three Dimensional object representations
[4L]
Polygon surfaces, Curves lines and Surfaces, Spline representations, Bezier Curves and Surfaces, B-Spline Curves, Beta Splines.

Unit VI: Three Dimensional Viewing
[4L]
Viewing Pipeline, Viewing Coordinates, Transformation from World to Viewing Coordinates, Projections: Parallel Projections, Perspective Projections

Unit VII:Visible- Surface Detection Methods and Shading
[4L]
Back-Face Detection, Depth-Buffer Method, A-Buffer Method, Scan-Line Method, Depth-Sorting Method , Polygon rendering methods, Gouraud and Phong Shading.

Suggested books:

1. D. Hearn and P. Baker, "Computer Graphics", Pearson.
2. James D. Foley, "Computer Graphics: Principles and Practice", Addison-Wesley

Paper Name: Formal Language and Automata
Paper Code: BCSE404
Contact: 3L+1T
Credits: 4
No. of Lectures: 40

Unit I: Fundamentals:
[3L]
Basic definition of set, operations on set, function, relation, graph & tree. Concept of String, substring, prefix and suffix, palindrome and language. Operations on String: Concatenation, Transpose. Concept of transition table and transition diagram, design of sequence detector.

Unit II: Finite State machine:
[10L]
Introduction to finite state model, finite state machine: definitions, capability & state equivalent, kth-equivalent concept, Moore machine & Mealy machine, equivalence of Moore and Mealy machine. Merger graph, Merger table, compatibility graph, information lossless machine, losslessness testing: testing table & testing graph, design of inverse machine. Minimization of FSM, Equivalence between two FSM's, Limitations of FSM.

Unit III: Finite Automaton:
[4L]
Deterministic finite automaton and non deterministic finite automaton. Transition diagrams and Language recognizers. Conversions and Equivalence: Equivalence between NFA with and without null transitions. NFA to DFA conversion, minimization of FA, Myhill Nerode theorem, applications of FA.

Unit IV: Regular Languages:
[4L]
Regular sets. Regular expressions, identity rules. Arden's theorem state and prove. Constructing finite Automata for a given regular expressions, Regular string accepted by NFA/DFA. Pumping lemma of regular

sets. Closure properties of regular sets (statement only). Grammar Formalism: Regular grammars-right linear and left linear grammars. Equivalence between regular linear grammar and FA.

Unit V: Regular Grammar:
[4L]
Definition, Grammar Formalism: Regular grammars-right linear and left linear grammars. Equivalence between regular linear grammar and FA. Chomsky classification, equivalence between grammar and language, equivalence between grammar and automata.

Unit VI: Context free grammar:
[5L]
Definition, ambiguity in context free grammars. Minimization of Context Free Grammars. Chomsky normal form and Greibach normal form, conversion of CFG to GNF, pumping Lemma for Context Free Languages. Closure property of CFL, Ogden's lemma.

Unit VII: Pushdown Automata:
[3L]
Definition, acceptance of CFL, Acceptance by final state, Equivalence of CFL and PDA, introduction to DCFL and DPDA.

Unit VIII: Turing Machine:
[3L]
Definition, model Design of TM, Computable functions, Church's hypothesis, counter machine, Types of Turing machines, Universal Turing Machine, Halting problem.

Suggested books:

1. KLP Mishra & Chandrasekaran - "Theory of Computer Science", 3rd ed. - PHI
2. ZVI Kohavi & Niraj K. Jha - "Switching and Finite Automata", 3rd ed. - CAMBRIDGE
3. Lewis & Papadimitriou - "Elements of the Theory of Computation", - PEARSON - PHI

Paper Name: Communicative English IV Lab
Paper Code: HU492
Contact: 4P
Credits: 2

Unit I: Phonetics

i) Pronunciation and Enunciation(Air stream mechanism,various organs of speech)
ii) Vowels and consonants
iii) Intonation(Clarity and modulation)

Practice of Skills through Language Laboratory

Unit II: Advanced Reading

i) Understanding business-related correspondences
ii) Comprehansion of factual material
iii) Interpreting visual information: Tables, Graphs, Charts

iv) Speed Reading Skills

Unit III: Listening Skill

i. Listening to a recording of the description of a place, event or incident for note-taking, identifying details, descriptions and overall idea.
ii. Listening to a recording of a lecture / talk on for note taking and identifying facts and drawing conclusions.
iii. Listening to a recording of a television panel discussion on any topic for identifying facts, analyzing those drawing inferences and explaining the conclusion of the discussion in a logical manner.
iv. Listening to passages that are read out for practicing note taking and identifying general and detailed content.
v. Listening to dialogues that are read out for identifying specific, general and detailed content.

UNIT IV: Writing Skills

i) Common Grammatical Errors: Errors of Syntax, Concord etc.
ii) Resume
iii) Cover Letter
iv) Presentation

Unit VI: Speaking Skills

i) Debate
ii) Group Discussion
iii) HR Questions
iv) Debate

Unit VII: Etiquettes and Grooming
i) Workplace
ii) Professional
iii)Netiquettes,
iv)Telephonic

Paper Name: Algorithms with Python Lab
Paper Code: BCSE491
Contact: 4P
Credits: 3

Unit I: Divide and Conquer
Week 1: Implement Merge sort, Implement Quicksort.
Week 2: Find maximum and minimum element from an array of integers using divide and conquer strategy.

Unit II: Greedy Strategy
Week 3: Implement fractional knapsack, Implement Job sequence with deadline
Week 4: Implement Dijkstra's algorithm, Implement Prim's algorithm
Week 5: Implement Kruskal's algorithm.

Unit III: Dynamic Programming
Week 6: Implement Matrix Chain Multiplication
Week 7: Implement Floyd Warshall Algorithm, Implement travelling salesman problem

Week 8: Implement Bellman Ford Algorithm
Unit IV: Backtracking
Week 9: Implement N-Queen problem

Unit V: Graph traversal algorithm
Week 10: Implement Breadth First Search(BFS) and Depth First Search

Unit VI: Branch and Bound
Week 11: Implement 15-Puzzle problem

Unit VII: String Matching Problem
Week 12: Implement KMP algorithm

Paper Name: Object Oriented System with Java Lab
Paper Code: BCSE492
Contact: 4P
Credits: 3

Unit-1 : Introduction to Java

Week1 : basic Java programs with different datatypes , branching and iterative statements. Compilation and interpretation of Java programs.

Unit-2 : Java class and Objects

Week2: Java programs with classes and objects. Implementation of Access Control Modifiers in class, programs with command line arguments.

Week3:Java programs with Array and String

Unit-3 : Java class constructors and method overloading

Week4: Java programs implementing function overloading,constructor and constructor overloading. Java programs with static datamembers and methods.

Unit-4 : Inheritance

Week5: Java progrms implementing inheritance by extending classes.Concept of abstract class.

Week6:Java progrms implementing inheritance with interfaces

Unit-5 : Threads and Objects

Week7: Java programs implementing Thread using Thread class and Runnable interface

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Week8: Thread continues....

Unit-6 : Collection framework

Week9: Java programs with ArrayList, Vector, List, Map,HashMap, Set, HashSet

Unit-7 : Java AWT and Applet

Week10: Java programs with AWT

Week11: Java programs with Applet

Unit-7 : Java Database Connectivity

Week12: Record insertion , updation, selection, deletion using Java Database Connectivity

Suggested Books:

1. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Paper Name: Computer Graphics Lab
Paper Code: BCSE493
Contact: 4P
Credits: 3

Unit-I : Introduction

Week1 : Introduction to python graphics library.

Unit-II : Output Primitives

Week2: Implementation of DDA line drawing algorithms.

Week3: Implementation of Bresenham's line drawing algorithms.

Week4: Implementation of Bresenham's circle drawing algorithm.

Week5: Implementation of midpoint circle drawing algorithm.

Week6: Implementation of midpoint ellipse generating algorithms.

Week7: Implementation of area filling algorithm.

Unit-III : Two Dimensional geometric transformations

Week8: Implementation of basic transformations

Week9: Implementation of basic transformations

Unit-IV: Clipping operations

Week10: Implementation of Cohen - Sutherland algorithm.

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DEPARTMENT OF COMPUTER SCIENCE
B.Tech Computer Science
Semester-4

Unit V: Three Dimensional object representations

Week11: Implementation of curves lines and surfaces generating algorithm.

Week12: Implementation of curves lines and surfaces generating algorithm.

Paper Name: Modern Application Development Lab-I
Paper Code: BCSE494
Contact: 4P
Credits: 3

Unit 1:Working with Java scripts:
Week 1:Working with Java scripts
Week 2:Working with Java scripts
Writing fundamental of java scripts,executing with web and building javascripts essentials

Unit 2:Working with Web apps:
Week 3:Building Web apps
Week 4:Building Web apps
Building basic web apps using node js and deployment to the web server.

Unit 3:Working with database:
Week 5: Working with NoSQL
Week 6: Working with NoSQL
Working with MongoDB.Connection with node js

Unit 4:Building Web apps:
Week 7:Building complete web app solution
Week 8:Building complete web app solution
Development of a complete web solution

Unit 5:Introduction to Android:
Week 9:Working With Android
Week 10:Working With Android

Understanding basic mobile apps,Introduction to Android SDK,Building small mobile apps.
Unit 5:Android development:
Week 11:Complete Mobile Application development through Android
Week 12:Complete Mobile Application development through Android

Development of complete mobile application project using Android.

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Course Structure: M-Tech (CSE) 2018

SEMESTER – I

Paper Code	Paper Name	L - T - P	Credits	Total Marks
MMAT010101	Applicable Mathematics	4 - 0 - 0	4	100
MCSE010401	Advanced Data Structures	4 - 0 - 0	4	100
MCSE010402	Advanced DBMS	4 - 0 – 0	4	100
MCSE010901	Advanced Data Structures Lab	0 – 0 – 3	2	100
MCSE010902	Advanced DBMS Lab	0 – 0 – 3	2	100
MCSE010903	C# / Dot Net Framework Lab	0 – 0 – 3	2	100
	Total		18	700

SEMESTER – II

Paper Code	Paper Name	L - T - P	Credits	Total Marks
MCSE020201	Advanced Algorithms	4- 0 – 0	4	100
MCSE020202	Computational Intelligence	4- 0 – 0	4	100
MCSE020203	Advance Operating System	4- 0 – 0	4	100
MCSE020204	Elective I – A. Machine Learning B. Data Science C. Wireless Sensor Network	4 - 0 – 0	4	100
MLAB020901	Advance Algorithms	0 – 0 – 3	2	100
MLAB020902	Advance Operating System	0 – 0 – 3	2	100
MPROJ020801	Android Apps & Python Lab	0 – 0 – 3	2	100
	Total		22	700

Atriot Bhattacharyya 12/12/18

12-12-18

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Course Structure: M-Tech (CSE) 2018

SEMESTER – III

Paper Code	Paper Name	L - T - P	Credits	Total Marks
MCSE030501	Elective II – 1. Mobile Computing 2. Software Project Management 3. Advanced Computer Architecture	4- 0 – 0	4	100
MCSE030502	Elective III – A. Bio-informatics B. Distributed System C. Network Security	4- 0 – 0	4	100
MCSE030503	Elective IV – A. Digital Signal Processing B. Pattern recognition C. Supply Chain Management	4- 0 – 0	4	100
MPROJ030801	Dissertation-I	--------	6	100
	Total		18	400

SEMESTER – IV

Paper Code	Paper Name	L - T - P	Credits	Total Marks
	Grand Viva	-------	2	100
MPROJ040801	Dissertation II	-------	10	100
	Total		12	200

BRAINWARE UNIVERSITY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
Course Structure: M-Tech (CSE) 2018

SEMESTER –I

Course Code: MMAT010101
Course Name Applicable Mathematics
Credits 4
Total Number of Lectures: 40

Unit 1 **[10L]**
Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains

Unit 2 **[10L]**
Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood

Unit 3 **[5L]**
Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.

Unit 4 **[15L]**
Graph Theory: Isomorphism, Planar graphs, graph colouring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems

References:
1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatories, Wiley

Course Code: MCSE010401
Course Name Advanced Data Structures
Credits 4
Total Number of Lectures: 40

Unit 1 **[7L]**
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing,

Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Unit 2 **[5L]**

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Unit 3 **[8L]**

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Unit 4 **[8L]**

Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Unit 5 **[8L]**

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.

Unit 6 **[4L]**

Recent Trends in Hashing, Trees, and various computational geometry methods for effeciently solving the new evolving problem

References:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Course Code: MCSE010402
Course Name Advanced DBMS
Credits 4
Total Number of Lectures: 40

Unit 1 **[10L]**

Overview of Distributed Database. Features of Distributed versus Centralized Database. DDBMSs. Reference architecture for Distributed Database. Levels of Distribution Transparency: for Read only applications and Update applications. Integrity Constraints in Distributed Database. Replication. Distributed Database design – Fragmentation and allocation of fragmentation.

Unit 2 **[10L]**

Translation of Global Queries. Transforming Global Queries into Fragmented Query. Global Query Optimisation. Query execution and access plan. A framework for Transaction Management. Atomicity of Distributed Transactions. Concurrency Control for Distributed Database- 2 phases locks. Distributed deadlocks. Concurrency Control based on Timestamp.

Unit 3 **[10L]**

Basic concept of Reliability. Non-blocking commitment protocols. Partitioned networks. Checkpoints and cold Restart. Management of distributed transactions- 2 phase unit protocols. Architectural aspects. Node and link failure recoveries.

Unit 4 **[10L]**

Distributed Data Dictionary Management. Distributed Database Administration. Heterogeneous Distributed Database System. Reference architecture, loosely and tightly coupled.

References:

1. Database System Concepts, Silberschatz Korth, Sudarshan, MH
2. Distributed Database, Tannenbaum, Pearson
3. Distributed Database: Principles & System, Stefano Ceri and Guiseppe Pelagatti, TMG
3. Principles of Distributed Database Systems, M. Tamerozsu Patrick Valduriez, Pearson

Course Code: MCSE010901
Course Name: Advanced Data Structure Lab
Credits 2
Total Number of Periods: 24

Unit 1: Linear Data Structure

Week 1: Implementation of array operations.

Week 2: Implementation of Singly linked lists: Inserting (Insert Begin, Insert End, Insert Before of a particular node, Insert after of a particular node), Searching, Deleting, Counting, Traversing, Reverse Traversing and Physically inverting a linked list.

Week 3: Implementation of Doubly linked lists: inserting, deleting, and inverting a linked list.

Week 4: Implementation of Circular linked lists: inserting, deleting, and inverting a linked list.

Week 5: Implementation of Stacks: Adding & deleting elements.
Implementation of Queues: Adding & deleting elements.

Week 6: Implementation of Circular Queue: Adding & deleting elements.
Evaluation of expressions operations on multiple stacks & queues.

Week 7: Implementation of stacks & queues using linked lists.

Unit 2: Searching and Sorting

Week 8: Implementation of Linear and Binary Search

Week 9: Implementation of Bubble sort, Insertion sort, Selection sort and Quick Sort.

Week 10: Implementation of Marge sort and Heap sort.

Unit 3: Non Linear Data Structure

Week 11: Recursive and Non recursive traversal of Trees.

Week 12: Application of Trees.

Course Code: MCSE010902
Course Name: Advance DBMS Lab
Credits 2
Total Number of Periods: 24

Unit-1 : DDL & DML
Week1 : create , alter, drop, truncate, DML- select, update, insert, delete

Unit-2 : Constraints
Week2: primary key, check constraint, unique, foreign key

Unit-3 : Set operations-
Week3: union, intersect, minus

Unit-4 : Joining
Week4: inner join, cross join, outer join, self join

Unit-5 : Aggregate functions
Week5: Aggregate functions- sum, count, avg, max, min, group by and having

Unit-6 : Ordering
Week6: order by clause, ascending and descending

Unit-7 : Views
Week7: Working with Views.

Unit-8 : PL-SQL
Week8: Introduction to PL/SQL blocks, variable declaration, printing output. PL-SQL operators.

Week9 : conditional statements and iterative statements

Week10: stored procedure, parameterized procedure, IN-OUT-INOUT type parameter. Calling a procedure from another procedure.

Week11: working with functions, difference between procedure and function. Limitation of functions.

Week12: working with cursors, triggers.

References:

a. SQL, PL/SQL the Programming Language of Oracle, Paperback, Ivan Bayross

Course Code: MCSE010903
Course Name: C# / Dot Net Framework Lab
Credits 2
Total Number of Periods: 24

Unit-1: Overview of .Net
Week 1 & 2
Introduction to .Net. Platform for the .Net. Drawbacks of Current Trend. Net Framework – BCL & CLR. Key design goals, CLR, CTS, MSIL & other tools. Multiple Language Interaction & support. Moving from Project to Assemblies. Security in .NET – CAS

Unit-2: .Net Framework [Advanced]
Week 3
Advantages/Disadvantages. Features of .Net., Visual C#.Net Language. Advantages/Disadvantages. Why C#/ Why Not C++. Where does C# Fit in C, C++ to Visual C# Features of C#

Unit-3: .NET Namespaces
Week 4 & 5
Architecture of .NET Framework applications and the features. Use basic Visual C# data types, operators, and expressions. Use standard Visual C# constructs.

Unit-4: Programming Using Visual C# .Net
Week 6
C# .Net Program Design. Variables and types. Value types and reference types (CTS). Strings and arrays. The Console class. String formatting. Statements and flows. Programming Structures. Command-line arguments.

Unit-5: Introduction to Windows Forms
Week 7 & 8
Windows forms library – Forms and controls. Creating simple GUI. Event handling. Basic controls. Windows forms – buttons, check boxes, radio buttons, panels, group boxes, list boxes, picture boxes. Menus: Built-in dialog boxes and printing. ToolStrips, StatusStrips and progress bars. A new MDI forms strategy. New Controls – Web Browser, Property Grid etc.

Unit-6: Object Oriented Concepts (Basic)
Week 9
Classes & objects. Abstract & override methods. Creating and using your own classes. Data members and member methods. Instantiate an object. This keyword. Build process using windows class library. Generate classes for other clients How to use classes as part of project.

Unit-7: Object Oriented Concepts (Advanced)
Week 10
Accessibility levels, Specifies Constructors. Method overloading. Class (static) variables & methods. Object destruction 'ref' and 'out' parameters. Constant values. Enumerations Inheritance and Polymorphism. The root of all classes. Creating derived classes Method overriding and hiding. Polymorphism and virtual functions. Casting objects. Abstract classes. Sealed classes. Static classes.

Unit-8: Ado.Net
Week 11 & 12
History and background From DAO to ADO.NET. ADO.NET LINQ ADO.NET design goals. The ADO.NET architecture and its components. ADO.NET in relation to the other .NET tools DataSet in RealTime Scenarious. ADO.Net Components. Connected and disconnected environment ADO.NET object model. Data sources, providers and connections. Commands and data readers. Data sets and data adaptors. Data tables, rows and columns. Constraints and relations. Data-centric applications – New ADO.Net Hierarchy. Data Sources and .Net Data Providers. Connecting to a data source SQL Server .NET data provider. OLE-DB .NET data provider. Connections and connection strings. SQL-Server integrated security. Connection pooling ADO.NET exceptions.

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Course Structure: M-Tech (CSE) 2018

SEMESTER –II

Course Code: MCSE020201
Course Name: Advanced Algorithms
Credits 4
Total Number of Lectures: 40

Unit 1 : **[8L]**
Sorting: Review of various sorting algorithms, topological sorting Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.

Unit 2 : **[10L]**
Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.

Unit 3 : **[8L]**
Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.

Unit 4 : **[8L]**
Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm

Unit 5 : **[6L]**
Linear Programming: Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm 10 Unit 6 Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.

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References:
1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.

Course Code: MCSE020202
Course Name: Computational Intelligence
Credits 4
Total Number of Lectures : 40

Unit 1 **[7L]**
INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS: Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics

Unit 2 **[8L]**
FUZZY LOGIC: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.

Unit 3 **[10L]**
NEURAL NETWORKS: Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks

Unit 4 **[5L]**
GENETIC ALGORITHMS: Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.

Unit 5 **[5L]**
Matlab /Python Lib: Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic

Unit 6 **[5L]**
Recent Trends in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques.

References:
1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice:Hall of India, 2003.

2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.
3. MATLAB Toolkit Manual

Course Code: MCSE020203
Course Name Advanced Operating System
Credits 4
Total Number of Lectures: 40

Unit-1: Process Synchronization **[6L]**
Concepts of processes, Concurrent processes, Threads, Overview of different classical synchronization problems, Monitors, Communicating Sequential processes(CSP) Process

Unit 2: Deadlocks **[6L]**
Introduction, causes of deadlocks, Deadlock handling strategies, Models of deadlock

Unit 3: Distributed operating system **[10L]**
Architectures, Issues in Distributed operating systems, Limitations of Distributed Systems, Lamport's logical clock, Global states, Chandy-Lampert's global state recording algorithm,Basic concepts of Distributed Mutual Exclusion ,Lamport's Algorithm, Ricart -Agrawala Algorithm;Basic concepts of Distributed deadlock detection, Distributed File system, Architecture, Design issues, SUN Network File system Basic concepts of Distributed shared memory, Basic concepts of Distrubuted Scheduling, Load balancing, Load sharing

Unit 4: Distributed OS Implementation **[8L]**
Models, Naming, Process migration, Remote Procedure Calls.

Unit 5: Multiprocessor System **[6L]**
Motivation, Classification, Multiprocessor Interconnections, Types, Multiprocessor OS functions & requirements; Design & Implementation Issue; Introduction to parallel programming; Multiprocessor Synchronization. Performance, Coprocessors, RISC & data flow Introduction, Necessity, Measures, Techniques, Bottlenecks & Saturation, Feedback loops, Coprocessors, RISC. Analytic Modeling Introductions, Queing Theory, Markov

Unit 6: Process Security & Protection **[4L]**
Security-threats & goals, Penetration attempts, Security Policies & mechanisms, Authentication, Protections & access control Formal models of protection, Cryptography, worms & viruses.

References:
1. Operating Systems Concepts & design - Milan Milenkovic, TMH
2. Operating System - H.M. Deitel, Pearsons .
3. Advanced Concepts in operating Systems - Mukesh Singhal and Niranjan G. Shivaratri, TMH

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Course Structure: M-Tech (CSE) 2018

Course Code: MCSE020204A
Course Name Machine learning
Credits 4
Total Number of Lectures: 40

Unit 1: **[10L]**
Supervised Learning (Regression/Classification) • Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes • Linear models: Linear Regression, Logistic Regression, Generalized Linear Models • Support Vector Machines, Nonlinearity and Kernel Methods • Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

Unit 2: **[8L]**
Unsupervised Learning • Clustering: K-means/Kernel K-means • Dimensionality Reduction: PCA and kernel PCA • Matrix Factorization and Matrix Completion • Generative Models (mixture models and latent factor models)

Unit 3: **[7L]**
Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)

Unit 4: **[7L]**
Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

Unit 5: **[8L]**
Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference. Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.

References:
1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

Course Code: MCSE020204B
Course Name Data Science
Credits 4

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Course Structure: M-Tech (CSE) 2018

Total Number of Lectures :40

Unit 1: **[5L]**
Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

Unit 2: **[5L]**
Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources

Unit 3: **[8L]**
Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Unit 4: **[8L]**
Data Visualisation: Introduction, Types of data visualisation, Data for visualisation:Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.

Unit 5: **[7L]**
Applications of Data Science,Technologies for visualisation, Bokeh (Python)

Unit 6: **[7L]**
Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

References:
1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press

Course Code: MCSE020204C
Course Name Wireless Sensor Network
Credits 4
Total Number of Lectures: 40

Unit 1: Characteristics of WSN **[10L]**
Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in

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WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

Unit 2: Medium Access Control Protocols **[8L]**

Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contentionbased protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

Unit 3: Routing And Data Gathering Protocols: **[12L]**

Routing Challenges and Design : Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

Unit 4: Embedded Operating Systems: **[6L]**

Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

Unit 5: Applications of WSN **[4L]**

WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.

References:

1. Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.
3. K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349
4. Philip Levis, " TinyOS Programming" 3.Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd,

Course Code: MLAB020901
Course Name: Advanced Algorithm Lab

Credits 2
Total Number of Periods: 24

Unit 1: Divide and Conquer
Week 1 : Implement Merge sort, Implement Quicksort.
Week 2 : Find maximum and minimum element from an array of integers using divide and conquer strategy.

Unit 2: Greedy Strategy
Week 3 : Implement fractional knapsack, Implement Job sequence with deadline
Week 4: Implement Dijkstra's algorithm, Implement Prim's algorithm
Week 5: Implement Kruskal's algorithm.

Unit 3: Dynamic Programming
Week 6: Implement Matrix Chain Multiplication
Week 7: Implement Floyd Warshall Algorithm

Week 8: Implement Bellman Ford Algorithm
Unit 4: Backtracking
Week 9 : Implement N-Queen problem
Week 10: Implement Graph Coloring Problem.

Unit 5: Branch and Bound
Week 11: Implement 15-Puzzle problem

Unit 6: String Matching Problem
Week 12: Implement KMP algorithm

Course Code: MLAB020902
Course Name: Advanced Operating System Lab
Credits 2
Total Number of Periods: 24

Unit 1: File Management
Week1: File management system calls: program to implement, Create a file, Copy one file to another, linking a file, Delete a file.

Unit 2: Directory Management
Week2: Directory management system calls: program to change directory and print its contents.

Unit 3: Process Management
Week3: Parent process – Child process Relationship.

Unit 4: IPC Implementation
Week4: Implementing IPC using pipes.

Unit 5: Scheduling Algorithm Implementation
Week5: Simulation of scheduling algorithms:
1)First Come First Serve
2)Shortest Remaining Job First
3)Round Robin
4)Preemptive Priority Scheduling

Unit 6: Semaphore Implementation
Week6: Implementation of semaphore: program that demonstrates how two processes can share a variable using semaphore.
Week7: Producer – Consumer Problem Using POSIX semaphores
Week8: Dinning Philosopher's problem.

Unit 7: Shell Implementation
Week9: Implementation of shell

Unit 8: Deadlock Algorithm Implementation
Week10: To implement Banker's algorithm for a multiple resources.

Unit 9: Shell Programming
Week11: Shell scripts.

Unit 10: Implementation of Page Replacement Algorithms
Week12: To study page replacement policies like
1) OPTIMAL
2) LEAST RECENTLY USED (LRU)
3) FIRST-IN-FIRST-OUT

Course Code: MPROJ020801
Course Name: Android Apps & Python Lab
Credits 2
Total Number of Periods: 24

Project has to be developed based on Android and/or Python in consultation with guide.

Semester - III

BRAINWARE UNIVERSITY
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Course Structure: M-Tech (CSE) 2018

Course Code: MCSE030501A
Course Name: Mobile Computing
Credits 4
Total Number of Lectures: 40

Unit-1: Introduction to Personal Communications Services (PCS) **[7L]**
PCS Architecture, Mobility management, Networks signalling. Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Network signalling.

Unit-2: General Packet Radio Services (GPRS) **[8L]**
GPRS Architecture, GPRS Network Nodes. Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.

Unit-3: Wireless Application Protocol (WAP) **[8L]**
The Mobile Internet standard, WAP Gateway and Protocols, wireless markup Languages (WML). Wireless Local Loop (WLL): Introduction to WLL Architecture, wireless Local Loop Technologies.

Unit-4: Third Generation (3G) **[9L]**
Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G.

Unit-5: Global Mobile Satellite Systems **[8L]**
Case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols.

Unit-5: Introduction to J2ME **[8L]**
Server-side programming in Java, Pervasive web application architecture, Device independent example application

References:

1. "Pervasive Computing", Burkhardt, Pearson
2. "Mobile Communication", J. Schiller, Pearson
3. "Wireless and Mobile Networks Architectures", Yi-Bing Lin & Imrich Chlamtac, John Wiley & Sons, 2001
4. "Mobile and Personal Communication systems and services", Raj Pandya, Prentice Hall of India, 2001.
5. "Guide to Designing and Implementing wireless LANs", Mark Ciampa, Thomson learning, Vikas Publishing House, 2001.
6. "Wireless Web Development", Ray Rischpater, Springer Publishing,

7. "The Wireless Application Protocol", Sandeep Singhal, Pearson .
8. "Third Generation Mobile Telecommunication systems", by P.Stavronlakis, Springer Publishers,

Course Code: MCSE030501B
Course Name: Software Project Management
Credits 4
Total Number of Lectures: 40

Unit-1: Project Management Concepts **[3L]**
Concept and Characteristics of a Project, Importance of Project Management.

Unit-2: Project Planning: Project Evaluation **[3L]**
Financial Sources, Feasibility Studies.

Unit-3: Project Scheduling: Importance of Project Scheduling **[6L]**
Work Breakdown Structure and Organization Breakdown Structure, Scheduling Techniques – Gantt Chart and LOB, Network Analysis – CPM/PERT.

Unit-4: Time Cost Trade-off Analysis **[4L]**
Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II A Parametric Productivity Model – Staffing Pattern, Optimum Project Duration.

Unit-5: Resource Allocation and Leveling **[3L]**
The Oldham-Hackman job characteristic model – Ethical and Programmed concerns – Working in teams – Decision making – Team structures – Virtual teams – Communications genres – Communication plans

Unit-6. Project Life Cycle **[3L]**
Project schedules – Activities – Sequencing and scheduling – Network Planning, Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules

Unit-7: Project Cost **[4L]**
Capital & Operating Costs, Project Life Cycle Costing, Project Cost Reduction Methods.

Unit-8: Project Quality Management: **[5L]**
Concept of Project Quality, TQM in Projects, Project Audit.

Unit-9: Software Project Characteristics and Management **[4L]**

Visualizing progress – Cost monitoring – Earned Value Analysis- Project tracking – Change control- Software Configuration Management – Managing contracts – Contract Management

Unit-10: IT in Projects **[5L]**
Overview of types of Softwares for Projects, Major Features of Project Management Softwares like MS Project, Criterion for Software Selection.

References:
1. Gopalkrishnan P. and Rama Mmoorthy: Text Book of Project Management, Macmillan
2. Nicholas John M.: Project Management for Business and Technology – Principles and Practice, Prentice Hall India, 2nd Edn.
3. Levy Ferdinand K., Wiest Jerome D.: A Management Guide to PERT/CPM with GERT/PDM/DCPM and other networks, Prentice Hall India, 2nd Edn.
4. Mantel Jr., Meredith J. R., Shafer S. M., Sutton M. M., Gopalan M. R.: Project Management: Core Text Book, Wiley India, 1 st Indian Edn.
5. Maylor H.: Project Management, Pearson, 3rd Edn.
6. Nagarajan K.: Project Management, New Age International Publishers, 5th Edn.
7. Kelkar. S.A, Sotware Project Management: A concise Study, 2nd Ed., PHI

Course Code: MCSE030501C
Course Name: Advanced Computer Architecture
Credits 4
Total Number of Lectures: 40

Unit-1: Computer Architecture and Organization-Review **[4L]**
Fundamentals of Computer Design, Technology Trends Cost Performance Analysis

Unit-2: Parallel Processing Architectures **[4L]**
Taxonomy- SISD, MISD, SIMD, MIMD, PRAM models

Unit-3: Data and Resource Dependencies **[4L]**
Program Partitioning and Scheduling, Control Flow vs. Data Flow

Unit-4: Network topologies **[4L]**
Static, Dynamic, Types of Networks RISC vs. CISC, Memory Hierarchy, Virtual Memory

Unit-5: Concepts of Pipelining **[4L]**
Instruction Pipelining, dynamic pipelining, arithmetic pipelines.

Unit-6: Multiprocessor **[8L]**
Multistage Networks, Cache Coherence, Synchronization, Message- passing

Unit-7: Vector Processing Principles **[4L]**
Instruction types, Compound, Vector Loops, Chaining

Unit-8: Array Processors **[2L]**
Structure, Algorithms

Unit-9: Data Flow Architecture **[6L]**
Graphs. Petri Nets, Static and Dynamic DFA, VLSI Computations

References:

1.Computer Architecture and Parallel Processing- Kai Hwang and A. Brigggs International Edition, McGraw Hill
2. Advanced Computer Architecture: D. Sima, T. fountain, P. Kacsuk, Pearson
3. Parallel Computer Architecture: D. Culler, J.P.Singh, A.Gupta, Elsevier

Course Code: MCSE030502A
Course Name Bio Informatics
Credits 4
Total Number of Lectures: 40

Unit-1: Cell Biology **[3L]**
System Biology, Central Dogma, Biological Database: Sequence data, Gene expression data, Micro-array experiment, NCBI database, Challenges faced in the integration of biological data, Data management and data integration in bio-informatics, Issues related to the designing of a biological information system.

Unit-2: Sequence similarity, homology, and alignment. Pair wise alignment: **[8L]**
Scoring model, dynamic Programming algorithms, heuristic alignment, and pair wise alignment using Hidden Markov models (HMM), Multiple alignment: scoring model, local alignment gapped and ungapped global alignment. Motif finding: motif models, finding occurrence of known sites, discovering new sites, Amino Acid, Protein, Phylogenetic tree construction: Neighbor Joining Algorithm.

Unit-3: Biological Pathways: **[4L]**
Gene regulatory network, Transcription factors, Signal Transduction, Protein-Protein interaction, Boolean Network, Stochastic gene networks, Network connectivity.

Unit-4: Clustering, Classification & Rule mining: **[15L]**
Clustering algoritms: k-means, k-medoid, Isodata, AGNES, DIANA, BIRCH, DBSCAN, CHAMELON, Grid based methods, Model based methods Classifier: Bayes theorem, Naïve Bayes classifier, Baysian belief network, Cluster validity indices: DB-Index, Dunn Index, Xie-Beni Index etc. Association rule Mining: Apriori, FP-Growth.

Unit-5: Statistical approach: **[10L]**
Information theory (Entropy), Prediction using linear regression, multiple regression, predicting reading frames, maximal dependence decomposition, Expectation-maximization, Bayesian model, Gaussian Mixture Model(GMM), P-value statistics(GO), z-score, t-test, F-test, Validation parameters: True positive, Sensitivity, Specificity, FDR, Accuracy.

References:

1. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, New York: Garland Science; 2002
2. Bioinformatics: Sequence and Genome Analysis, David W. Mount, Cold Spring Harbor Laboratory Press
3. Bioinformatics And Functional Genomics: A Short Course, Jonathan Pevsner, Wiley-Liss
4. Data Mining Concepts and tecniques, Han & Kamber,Elsevier
5. Introduction to Bioinformatics, Arthur M. Lesk, Oxford University Press
6. Developing Bioinformatics Computer Skills,Cynthia Gibas, Per Jambeck,O'Reilly
7. An Introduction to Bioinformatics Algorithms,Neil C. Jones, Pavel A. Pevzner,MIT Press (MA)

Course Code: MCSE030502B
Course Name: Distributed System
Credits 4
Total Number of Lectures: 40

Unit-1: Introduction **[6L]**
Examples of Distributed Systems–Trends in Distributed Systems – Focus on resource sharing – Challenges. Case study: World Wide Web.

Unit-2: Communication in distributed system **[8L]**
System Model – Inter process Communication – the API for internet protocols – External data representation and Multicast communication. Network virtualization: Overlay networks. Case study: MPI Remote Method Invocation And Objects: Remote Invocation – Introduction – Request-reply protocols – Remote procedure call – Remote method invocation. Case study: Java RMI – Group communication – Publish-subscribe systems – Message queues – Shared memory approaches – Distributed objects – Case study: Enterprise Java Beans -from objects to components.

Unit-3 : Peer to peer services and file system **[9L]**
Peer-to-peer Systems – Introduction – Napster and its legacy – Peer-to-peer – Middleware – Routing overlays. Overlay case studies: Pastry, Tapestry- Distributed File Systems –Introduction – File service architecture – Andrew File system. File System: Features-File model -File

accessing models – File sharing semantics Naming: Identifiers, Addresses, Name Resolution – Name Space Implementation – Name Caches – LDAP.

Unit-4: Synchronization and replication **[9L]**

Introduction – Clocks, events and process states – Synchronizing physical clocks- Logical time and logical clocks – Global states – Coordination and Agreement – Introduction – Distributed mutual exclusion – Elections – Transactions and Concurrency Control– Transactions -Nested transactions – Locks – Optimistic concurrency control – Timestamp ordering – Atomic Commit protocols -Distributed deadlocks – Replication – Case study – Coda.

Unit-5: Process & resource management **[8L]**

Process Management: Process Migration: Features, Mechanism – Threads: Models, Issues, Implementation. Resource Management: Introduction- Features of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach.

Reference:

1. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems Concepts and Design", Third Edition, Pearson Education.
2. A.S. Tanenbaum, M. VanSteen, "Distributed Systems", Pearson Education.
3. Mukesh Singhal, "Advanced Concepts in Operating Systems", McGraw-Hill Series in Computer Science.

Course Code: MCSE030502C
Course Name: Network Security
Credits 4
Total Number of Lectures: 40

Unit 1: Introduction **[4L]**

Attacks, Services, Mechanisms, Security Attacks, Security Services, Model for Network Security

Unit 2: Conventional Encryption and Message Confidentiality **[10L]**

Conventional Encryption Principles, Conventional Encryption Algorithms, Location of Encryption Devices, Key Distribution Public Key Cryptography and Message Authentication Approaches to Message Authentication, SHA-1, MD5, Public-Key Cryptography Principles, RSA, Digital Signatures, Key Management

Unit 3: Network Security Applications **[6L]**

Kerberos Motivation, Kerberos Version 4, PGP Notation, PGP Operational Description

Unit 4: IP Security **[4L]**

IP Security Overview, IP Security Architecture, Authentication Header

Unit 5: Web Security **[6L]**
Web Security Threats, Web Traffic Security Approaches, Overview of Secure Socket Layer and Transport Layer Security, Overview of Secure Electronic Transaction

Unit 6: Intruders and Viruses **[6L]**
Intruders, Intrusion Techniques, Password Protection, Password Selection Strategies, Intrusion Detection, Malicious Programs, Nature of Viruses, Types of Viruses, Macro Viruses, Antivirus Approaches

Unit 7: Firewalls **[4L]**
Firewall Characteristics, Types of Firewalls, Firewall Configuration

Reference:
1. "Network Security Essentials: Applications and Standards" by William Stallings, Pearson
2. "Network Security private communication in a public world", C. Kaufman, R. Perlman and M. Speciner, Pearson
3. "Cryptography and Network Security", William Stallings, 2nd Edition, Pearson Education Asia
4. "Designing Network Security", Merike Kaeo, 2nd Edition, Pearson Books
5. "Building Internet Firewalls", Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition, Oreilly
6. "Practical Unix & Internet Security", Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly

Course Code: MCSE030503A
Course Name Digital Signal Processing
Credits 4
Total Number of Lectures: 40

Unit 1: Introduction **[2L]**
Overview of digital signal processing

Unit 2: Review of Discrete – Time linear system **[4L]**
Sequences, arbitrary sequences, linear time invariant system, causality, stability. Difference equation, relation between continuous and discrete system. Classifications of sequence,

Unit 3: Recursive and non-recursive system **[4L]**
Review of Mathematical operations on sequences: Convolution, graphical and analytical techniques, overlap and add methods, matrix method, some examples and solutions of LTI systems, MATLAB examples.

Unit 4 : Z-transform **[8L]**

Definition, relation between Z transform and Fourier transform of a sequence, properties of Z transform, mapping between S-plane and Z-plane. Unit circle, convergence and ROC, Inverse Z-transform, solution of difference equation using the one sided Z-transform MATLAB examples.

Unit 5: Discrete Fourier transform **[10L]**

Definition, inverse discrete Fourier transform (IDFT) Twiddle factor, linear transformation, basic properties, circular convolution, multiplication of DFT, linear filtering using DFT, filtering of long data sequences, overlap add and save method. Computation of DFT, Fast Fourier transform (FFT), FFT algorithm, Radix 2 algorithm. Decimation-in-time and decimation-in- frequency algorithm, signal flow graph, butterflies, Chirp z-transform algorithm, MATLAB examples.

Unit 6: Digital filter realization **[12L]**

Principle of digital filter realization, structures of All-zero filters. Design of FIR (Finite impulse response) filters, linear phase, windows-rectangular, Berlitt, Hanning, Hamming and Blackman. Design of infinite impulse response filters (IIR) from analog filters. Bilinear transformation, Butterworth, Chebyshev, Elliptic filters. Optimisation method of IIR filters. Some example of practical filter design. Computer aided filter design, MATLAB examples .

References:

1. "Digital Signal Processing", Ifeachor, Pearson
2. "Understanding Digital Signal Processing", R. G. Lyons, Pearson
3. "Theory and Application of Digital Signal Processing", L.R. Rabiner & B.Gold, PHI
4. "Digital Signal Processing, Principles, Algorithms and Applications", J.G. Proakis & D.G. Manolakis, PHI
5. "Digital Signal Processing", S. Salivahanan et al, TMH

Course Code: MCSE030503B
Course Name: Pattern Recognition
Credits 4
Total Number of Lectures: 40

Unit -1: Introduction **[4L]**

Examples; The nature of statistical pattern recognition; Three learning paradigms; The sub-problems of pattern recognition; The basic structure of a pattern recognition system; Comparing classifiers.

Unit 2: Bayes Decision Theory **[5L]**

General framework; Optimal decisions; Classification; Simple performance bounds.

Unit 3: Learning - Parametric Approaches **[6L]**

Basic statistical issues; Sources of classification error; Bias and variance; Three approaches to classification: density estimation, regression and discriminant analysis; Empirical error criteria; Optimization methods; Failure of MLE;

Unit 4: Parametric Discriminant Functions **[4L]**
Linear and quadratic discriminants; Shrinkage; Logistic classification; Generalized linear classifiers; Perceptrons; Maximum Margin; Error Correcting Codes;

Unit 5: Error Assessment **[6L]**
Sample error and true error; Error rate estimation; Confidence intervals; Resampling methods; Regularization; Model selection; Minimum description length; Comparing classifiers

Unit 6: Nonparametric Classification **[6L]**
Histograms rules; Nearest neighbor methods; Kernel approaches; Local polynomial fitting; Flexible metrics; Automatic kernels methods

Unit 7: Feature Extraction **[6L]**
Optimal features; Optimal linear transformations; Linear and nonlinear principal components; Feature subset selection; Feature Extraction and classification stages, Unsupervised learning and clustering, Syntactic pattern recognition, Fuzzy set Theoretic approach to PR,

Unit 8: Margins and Kernel Based Algorithms **[2L]**
Advanced algorithms based on the notions of margins and kernels

Unit 9: Applications of PR **[1L]**
Speech and speaker recognition, Character recognition, Scene analysis.

Course Code: MCSE030503
Course Name: Supply Chain Management
Credits 4
Total Number of Lectures: 40

Unit 1: Building Blocks, Performance Measures, Decisions **[4L]**
Building Blocks of a Supply Chain Network, Performance Measures, Decisions in the Supply Chain World, Models for Supply Chain Decision-Making

Unit 2: Supply Chain Inventory Management **[5L]**
Economic Order Quantity Models, Reorder Point Models, Multiechelon Inventory Systems

Unit 3: Mathematical Foundations of Supply Chain Solutions **[12L]**
Use of Stochastic Models and Combinatorial Optimization in:

Supply Chain Planning
Supply Chain Facilities Layout
Capacity Planning
Inventory Optimization
Dynamic Routing and Scheduling

Unit 4: Case Studies **[10L]**
Digital Equipment Case Study
IBM Case Study

Unit 5: Internet Techologies and Electronic Commerce in SCM **[9L]**
Relation to ERP, E-procurement, E-Logistics, Internet Auctions, E-markets, Electronic business process optimization, Business objects in SCM

References:

1. N. Viswanadham. Analysis of Manufacturing Enterprises. Kluwer Academic Publishers.
2. Y. Narahari and S. Biswas. Supply Chain Management: Models and Decision Making
3. Ram Ganeshan and Terry P. Harrison. An Introduction to Supply Chain Management
4. D. Connors, D. An, S. Buckley, G. Feigin, R. Jayaraman, A. Levas, N. Nayak, R. Petrakian, R. Srinivasan. Dynamic modelling for business process reengineering. IBM Research Report 1994, 1995

BRAINWARE UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure: M-Tech (CSE) 2018

SEMESTER – I

Paper Code	Paper Name	L - T - P	Credits	Total Marks
MMAT010101	Applicable Mathematics	4 -0– 0	4	100
MCSE010401	Advanced Data Structures	4 - 0- 0	4	100
MCSE010402	Advanced DBMS	4 - 0 – 0	4	100
MCSE010901	Advanced Data Structures Lab	0 – 0 – 3	2	100
MCSE010902	Advanced DBMS Lab	0 – 0 – 3	2	100
MCSE010903	C# / Dot Net Framework Lab	0 – 0 – 3	2	100
	Total		18	700

SEMESTER – II

Paper Code	Paper Name	L - T - P	Credits	Total Marks
PCC-MCS201	Advanced Algorithms	4- 0 – 0	4	100
PCC-MCS202	Computational Intelligence	4- 0 – 0	4	100
PCC-MCS203	Advanced Operating System	4- 0 – 0	4	100
PEC-MCS201	Elective I – A. Machine Learning B. Data Science C. Wireless Sensor Network	4 - 0 – 0	4	100
PCC-MCS291	Advance Algorithms	0 – 0 – 3	2	100
PCC-MCS292	Advanced Operating System	0 – 0 – 3	2	100
PCC-MCS293	Android Apps & Python Lab	0 – 0 – 3	2	100
	Total		22	700

BRAINWARE UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Course Structure: M-Tech (CSE) 2018

SEMESTER – III

Paper Code	Paper Name	L - T - P	Credits	Total Marks
PEC-MCS301	Elective II – A. Mobile Computing B. Software Project Management C. Advanced Computer Architecture	4-0-0	4	100
PEC-MCS302	Elective III – A. Bio-informatics B. Distributed System C. Network Security	4-0-0	4	100
PEC-MCS303	Elective IV – A. Digital Signal Processing B. Pattern recognition C. Supply Chain Management	4-0-0	4	100
PROJ-MCS381	Dissertation-I	--------	6	100
	Total		18	400

SEMESTER – IV

Paper Code	Paper Name	L - T - P	Credits	Total Marks
PROJ-MCS481	Dissertation II	-------	10	100
MCS482	Grand Viva	-------	2	100
	Total		12	200

BRAINWARE UNIVERSITY
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
Course Structure: M-Tech (CSE) 2018

SEMESTER –I

Course Code: MMAT010101
Course Name Applicable Mathematics
Contact: 4L
Credits: 4
Total Number of Lectures: 40

Unit 1 **[10L]**

Probability: Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains

Unit 2 **[10L]**

Sampling: Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood

Unit 3 **[5L]**

Statistical inference: Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.

Unit 4 **[15L]**

Graph Theory: Isomorphism, Planar graphs, graph colouring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems

Text Books:

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatories, Wiley

Course Code: MCSE010401
Course Name Advanced Data Structures
Contact: 4L
Credits: 4
Total Number of Lectures: 40

BRAINWARE UNIVERSITY
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
Course Structure: M-Tech (CSE) 2018

Unit 1 **[7L]**
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

Unit 2 **[5L]**
Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

Unit 3 **[8L]**
Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

Unit 4 **[8L]**
Text Processing: String Operations, Brute-Force Pattern Matching, The Boyer Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

Unit 5 **[8L]**
Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.

Unit 6 **[4L]**
Recent Trends: Hashing, Trees, and various computational geometry methods for effeciently solving the new evolving problem

Text Books:
1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Course Code: MCSE010402
Course Name Advanced DBMS
Contact: 4L
Credits: 4
Total Number of Lectures: 40

Unit 1 **[10L]**

Overview of Distributed Database: Features of Distributed versus Centralized Database. DDBMSs. Reference architecture for Distributed Database. Levels of Distribution Transparency: for Read only applications and Update applications. Integrity Constraints in Distributed Database. Replication. Distributed Database design – Fragmentation and allocation of fragmentation.

Unit 2 **[10L]**

Global Queries: Translation of Global Queries. Transforming Global Queries into Fragmented Query. Global Query Optimisation. Query execution and access plan. A framework for Transaction Management. Atomicity of Distributed Transactions. Concurrency Control for Distributed Database- 2 phases locks. Distributed deadlocks. Concurrency Control based on Timestamp.

Unit 3 **[10L]**

Reliability: Basic concept of Reliability. Non-blocking commitment protocols. Partitioned networks. Checkpoints and cold Restart. Management of distributed transactions- 2 phase unit protocols. Architectural aspects. Node and link failure recoveries.

Unit 4 **[10L]**

Advanced Topics: Distributed Data Dictionary Management. Distributed Database Administration. Heterogeneous Distributed Database System. Reference architecture, loosely and tightly coupled.

Text Books:

1. Database System Concepts, Silberschatz Korth, Sudarshan, MH
2. Distributed Database, Tannenbaum, Pearson
3. Distributed Database: Principles & System, Stefano Ceri and Guiseppe Pelagatti, TMG
3. Principles of Distributed Database Systems, M. Tamerozsu Patrick Valduriez, Pearson

Course Code: MCSE010901
Course Name: Advanced Data Structure Lab
Contact: 3P
Credits: 2
Total Number of Periods: 24

Unit 1: Linear Data Structure

Week 1: Implementation of array operations.

Week 2: Implementation of Singly linked lists: Inserting (Insert Begin, Insert End, Insert Before of a particular node, Insert after of a particular node), Searching,

Deleting, Counting, Traversing, Reverse Traversing and Physically inverting a linked list.

Week 3: Implementation of Doubly linked lists: inserting, deleting, and inverting a linked list.

Week 4: Implementation of Circular linked lists: inserting, deleting, and inverting a linked list.

Week 5: Implementation of Stacks: Adding & deleting elements.
Implementation of Queues: Adding & deleting elements.

Week 6: Implementation of Circular Queue: Adding & deleting elements.
Evaluation of expressions operations on multiple stacks & queues.

Week 7: Implementation of stacks & queues using linked lists.

Unit 2: Searching and Sorting

Week 8: Implementation of Linear and Binary Search

Week 9: Implementation of Bubble sort, Insertion sort, Selection sort and Quick Sort.

Week 10: Implementation of Marge sort and Heap sort.

Unit 3: Non Linear Data Structure

Week 11: Recursive and Non recursive traversal of Trees.

Week 12: Application of Trees.

Course Code: MCSE010902
Course Name: Advanced DBMS Lab
Contact: 3P
Credits: 2
Total Number of Periods: 24

Unit-1 : DDL & DML
Week1 : create , alter, drop, truncate, DML- select, update, insert, delete

Unit-2 : Constraints
Week2: primary key, check constraint, unique, foreign key