3rd Semester Computer Engineering

Sr. No.	Category of Subject	Course Code	Course Name	Teaching Scheme			Evaluation Scheme				
				L	T	P	CA	MSE	ESE	Total	Credit
1	PCC	CS3T001	Data structure & Algorithms	3	1	0	20	20	60	100	4
2	PCC	CS3T002	Discrete Mathematics & Graph Structures	3	1	0	20	20	60	100	4
3	PCC	CS3T003	FLAT	3	0	0	20	20	60	100	3
4	HSMC	CS3T004	Business Communication	2	0	0	20	20	60	100	2
5	PCC	CS3T005	Operating System	3	0	0	20	20	60	100	3
6	ESC	CS3L006	Web Designing Lab	0	0	4	40	0	60	100	2
7	PCC	CS3L007	Data structure and Algorithms(Lab)	0	0	2	40	0	60	100	1
8	PCC	CS3L008	Operating System (Lab)	0	0	2	40	0	60	100	1
9	PROJECT	CS3F009	Internship	0	0	0	0	0	0	0	1
				14	2	8	220	100	480	800	21

Course Title	:	Data Structure & Algorithms		Semester	:	III
Course Code	:	CS3T001	Course Type :	Compulsory		
Pre-requisite	:	C Programming	L – T – P	:	3 – 1– 0	
Stream	:	Core	Credits	:	4	

COURSE OBJECTIVES

1	To understand the concepts of ADTs.
2	To learn linear data structures – lists, stacks, and queues
3	To understand sorting, searching and hashing algorithms.
4	To apply Tree and Graph structures.

[Unit 1]   4 Hrs
Complexity Analysis: Time and Space complexity of algorithms, asymptotic analysis, big O and other notations, importance of efficient algorithms, program performance measurement, data structures and algorithms.

[Unit 2]   6 Hrs
ADT Array-Searching and sorting on arrays: Linear search, binary search on a sorted arrays. Bubble sort, Insertion sort, merge sort and analysis; Emphasis on the comparison based sorting model, Counting sort, Radix sort, and bucket sort

[Unit 3]   8 Hrs
Stacks and Queues: Abstract data types, sequential and linked implementations, exception handling in classes, representative applications such as parenthesis matching, towers of Hanoi, wire routing in a circuit, finding path in a maze, simulation of queuing systems, equivalence problem.

[Unit 4]   8 Hrs
Linked Lists: Abstract data type, sequential and linked representations, comparison of insertion, deletion and search operations for sequential and linked lists, list and chain classes, exception and iterator classes for lists, doubly linked lists, circular lists, linked lists through simulated pointers, lists in STL, skip lists, applications of lists in bin sort, radix sort, sparse tables.

[Unit 5]   8 Hrs
Trees: Binary trees and their properties, terminology, sequential and linked implementations, tree traversal methods and algorithms, heaps as priority queues, heap implementation, insertion and deletion operations, heap sort, heaps in Huffman coding, leftist trees, tournament trees, use of winner trees in merge sort as an external sorting algorithm, bin packing.

[Unit 6]   6 Hrs
Graphs: Breadth first search and connected components, Depth first search in directed and undirected graphs.

Text Books:
 1. Mark Allen Weiss, ―Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education,1997.
 2. Reema Thareja, ―Data Structures Using C, Second Edition , Oxford University Press, 2011

Reference Books:
 1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, ―Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
 2. Aho, Hopcroft and Ullman, ―Data Structures and Algorithms‖, Pearson Education,1983.
 3. Stephen G. Kochan, ―Programming in C‖, 3rd edition, Pearson Education.
 4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, ―Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

COURSE OUTCOMES

1	Student shall be able to Implement abstract data types for linear data structures.
2	Student shall be able to apply the different linear and non-linear data structures to problem solutions
3	Student shall be able to Critically analyze the various sorting algorithms

Course Title   : Discrete Mathematics & Graph Structures   Semester   :   III
Course Code   : CS3T002   Course Type :   Compulsory
Pre-requisite : Basic Mathematics   L – T – P   :   3 – 1– 0
Stream   : Core   Credits   :   4

[Unit 1]   6 Hrs
Set Theory: Basic concepts of Set theory, Power set, some operations on Sets, Venn diagram, some basic set identities, Cartesian products. Properties of binary relation in a set, Inclusion & equality of set, Power Set, Ordered Pairs and n-tuples, Operations on Sets**.**

Mathematical Logic: Statement and notations, connectives, Negation, conjunction, disjunction, conditional & bi-conditional, statement formulas & truth tables. Tautologies, equivalence of formulas, Duality law, Tautological implications, Arguments and validity.

[Unit 2]   6 Hrs
Relations and Functions: Relation and Ordering, Properties of Binary in a set, Relation Matrix and Graphs, Partition and Covering of a set, Equivalence relation, Partial ordering, Partially Ordered sets, Function (Definition and Introduction), Composition of functions, Inverse Functions, Characteristics function of a set.

[Unit 3]   6 Hrs
Algebraic structures: Semi groups, monoids definition and examples, Group definitions and examples, cyclic group, permutation groups, subgroups and homomorphism, co-sets, Lagrange's theorem and Normal Subgroups.

[Unit 4]   6 Hrs
Introduction to graphs: Graphs and their basic properties - degree, path, cycle, subgraphs, isomorphism, Eulerian and Hamiltonian walks, graph coloring, planar graphs, trees.

[Unit 5]   6 Hrs
Introduction to counting: Basic counting techniques - inclusion and exclusion, pigeon-hole principle, permutation, combination, summations. Introduction to recurrence relation and generating function.

[Unit 6]   6 Hrs
Random variables and probability distribution: Random variables: discrete and continuous; probability density function of one and two variables; Probability distribution function for discrete and continuous random variables (one and two variables), Joint distributions, conditional distributions.

Textbooks:
1. Discrete and Combinatorial Mathematics, Ralph P. Grimaldi & B. V. Ramana, 5   [th] Edition, PHI/Pearson education.
2.   "Discrete Mathematical structures", Dr D. S. Chandrashekariah, Prism 2005.
3.   S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7th Revied and Enlarged Edition, 2016.

Reference Books:

1. "Discrete Mathematics and its Applications", Kenneth H. Rosen, 6th Edition, McGraw Hill, 2007.
2. "Discrete Mathematical Structures: Theory and Applications ", D. S. Malik and M. K. Sen, Thomson, 2004.
3. "Discrete Mathematical structures", Kolman Busby Ross, 5th edition , PHI.
4. Kishor S. Trivedi, Probability, Statistics with Reliability, Queuing and Computer Science Applications, Wiley India Pvt. Ltd, 2nd Edition, 2001.

Course Title : Formal Language and Automata Theory (FLAT)   Semester   :   III
Course Code :   CS3T003   Course Type : Compulsory
Pre-requisite :   Logical Concepts   L – T – P   :   3 – 0– 0
Stream   :   Core   Credits   :   3

COURSE OBJECTIVES

1	To Introduce students to the mathematical foundations of computation including automata theory; the theory of formal languages and grammars; the notions of algorithm, decidability, complexity, and computability.
2	To Enhance/develop students' ability to understand and conduct mathematical proofs for computation and algorithms

[Unit 1]   8 Hrs
Fundamentals :   Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and nondeterministic finite automaton, transition diagrams and Language recognizers.
Finite Automata: Introduction to Finite Automata, Structural Representations, Automata and Complexity, Central Concepts of Automata Theory, DFA, NFA, and NFA & epsilon Machine. Conversions and Equivalence: Equivalence between NFA with and without epsilon transitions, NFA to DFA conversion, minimization of FSM, equivalence between two FSM's, Finite Automata with output-Moore and Melay machines.

[Unit 2]   7 Hrs
Regular Languages :   Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Properties of Regular Languages, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions, Pumping Lemma for Regular Languages, Applications of the Pumping Lemma, Closure Properties of Regular Languages, Decision Properties of Regular Languages.
Grammar Formalism: Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion, Context free grammar, derivation trees, sentential forms, Right most and leftmost derivation of strings.

[Unit 3]   6 Hrs
Context Free Grammars : Context-Free Grammars: Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Sentential Forms, Parse Tress, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages.
Push-Down Automata: Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence, Equivalence of CFL and PDA, interconversion,Introduction to DCFL and DPDA.

[Unit 4]   6 Hrs
Turing Machine :   Definition of Recursive and Recursively Enumerable , Church's Hypothesis , Computable Functions , Methods for Turing Machine Construction, Modifications of the Basic Turing Machine Model, Multiple Tape , Multiple Tracks, Non-determinism, etc. Equivalence of the different TM Models and the Basic TM Model.

[Unit 5]   7 Hrs

Computability Theory :   Chomsky hierarchy of languages, linear bounded automata and context sensitive language, LR(0) grammar, decidability of, problems, Universal Turing Machine, undecidability, Posts Correspondence problem, Turing reducibility, Definition of P and NP problems, NP complete and NP hard problems.

TEXT BOOKS :
1. "Introduction to Automata Theory Languages and Computation". Hopcroft H. E. and Ullman J. D. Pearson Education.
2. Introduction to Theory of Computation – Sipser 2nd edition Thomson .

REFERENCES BOOKS:
1. Introduction to Formal languages Automata Theory and Computation Kamala Krithivasan Rama R.
2. Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
3. Theory of Computation: A Problem - Solving Approach, Kavi Mahesh, Wiley India Pvt. Ltd.
4. "Elements of Theory of Computation", Lewis H.P. & Papadimition C.H. Pearson /PHI.
5. Theory of Computer Science – Automata languages and computation -Mishra and Chandrashekaran, 2nd edition, PHI.

COURSE OUTCOMES

1	Students shall able to Define the mathematical principles behind theoretical computer science.
2	Students shall able to Differentiate and give examples for the different types of automata like finite automata, push down automata, linear bounded automata and turing machine
3	Students shall able to Correlate the different types of automata to real world applications
4	Students shall able to Choose and design appropriate automata for the different requirements outlined by theoretical computer science
5	Students shall able to Identify the different computational problems and their associated complexity.

Course Title	:	Business Communication	Semester	:	III

Course Title : Business Communication **Semester :** III
Course Code : CS3T004 **Course Type :** Compulsory
Pre-requisite : Nil **L – T – P :** 2 – 0– 0
Stream : Core **Credits :** 2

COURSE OBJECTIVES

1	To provide an overview of Prerequisites to Business Communication.
2	To put in use the basic mechanics of Grammar.
3	To provide an outline to effective Organizational Communication.
4	To underline the nuances of Business communication.
5	To impart the correct practices of the strategies of Effective Business writing.

[Unit 1]   6 Hrs
Communication Skills: Fundamentals of Effective Communication, Public Speaking: fundamentals of effective public speaking, types- Extempore speech, manuscript speech, and ways to enhance public speaking skills, storytelling, oral review, types of communication- verbal and nonverbal communication, barriers of communication.
Listening Skills : Law of nature, Importance of listening skills, Difference between listening and hearing, types of listening.

[Unit 2]   6 Hrs
Interpersonal Skills: Team work, Team effectiveness, Group discussion, Decision making, Team Communication. Team, Conflict Resolution, Team Goal Setting, Team Motivation Understanding Team Development, Team Problem Solving, Building the team dynamics. Multicultural team activity.
Presentation Skills: PowerPoint presentations, Effective ways to structure the presentation, importance of body language**.**

[Unit 3]   6 Hrs
Leadership Skills: Leader's Role, Responsibilities and Skill Required: Understanding good Leadership behaviours, Learning the difference between Leadership and Management, Gaining insight into your Patterns, Beliefs and Rules, Defining Qualities and Strengths of leadership, Determining how well you perceive what's going on around you, interpersonal Skills and Communication Skills, Learning about Commitment and How to Move Things Forward, Making Key Decisions, Handling Your and Other People's Stress, Empowering, Motivating and Inspiring Others, Leading by example, effective feedback.
Team Building and Team Work: Aspects of team building- skills needed for teamwork –A model of team building, Team vs. Group, Characteristics of effective team, Role of team leader, Inter group collaboration, factors shaping inter-group collaboration

[Unit 4]   6 Hrs
Corporate / Business Etiquettes: Corporate grooming & dressing, etiquettes in social & office Setting- Understand the importance of professional behaviour at the work place, Understand and Implement etiquettes in workplace, presenting oneself with finesse and making others comfortable in a business

setting. Importance of first impression, Grooming, Wardrobe, Introduction to Ethics in engineering and ethical reasoning, rights and responsibilities

Technology Etiquettes: Phone, Email, Social media, Video conferencing, Web interviews.

[Unit 5]   6 Hrs

Professional manners: Social skills, interacting with people. Politeness and amicability, supportiveness, valuing time, respectfulness, Mobile manners, Table etiquettes. Professional etiquettes: Etiquettes at meeting, dining.

Conflict management: Definition, types of conflict management, communication, emotional Intelligence, creative problem solving, Empathy, Apologizing, Avoiding Punishments, Being Present, Calmness, Impartiality, Intuitiveness, Ability to "Let It Go", Patience, Positivity, Ability to Prioritize Relationships, Respecting Differences, Separating Yourself, Stress management, Ability to Take Criticism, crises communication.

[Unit 6]   6 Hrs

 Written Communication : Letter Writing –Formal and Informal letter writing, Application letters, Report writing: academic and business report, Job application letter.

Business Correspondence: Writing business letters, Memos, placing orders, Invoice, quotations. Exercise: Writing letters.

Text Books:

1. Business Communication Today by Bovee, Thill, Raina
2. Business Communication by K. K. Sinha, Taxmann
3. Introduction to Business: A Societal Approach by Walter W. Perlick and Raymond V. Lesikar, Business Publications.

Reference Books:

1. "Negotiation and Conflict Management Essays on Theory and Practice" by I. William Zartman available from Rakuten Kobo.
2. "Strategic Writing: Multimedia Writing for Public Relations, Advertising and More" . by Charles Marsh , David W. Guth.

COURSE OUTCOMES

1	Student shall be able to identify key principles in business communication.
2	Student shall be able to describe different processes and considerations involved in business.
3	Student shall be able to illustrate the appropriate use of different channels of written communication in business
4	Student shall be able to Categorize traditional and online tools and methods to find, evaluate, and process information
5	Students shall be able to evaluate various types of business reports.
6	Student shall be able to analyze on various types of business messages, including informative messages, team-focused messages, criticism, and response messages.

| Course Title | : | Operating System | Semester | : | III |

Course Title   :   **Operating System**   Semester   :   **III**
Course Code   :   **CS3T005**   Course Type   :   **Compulsory**
Pre-requisite   :   **CAO, Data Structure**   L – T – P   :   **3 – 0– 0**
Stream   :   **Core**   Credits   :   **3**

COURSE OBJECTIVES

1	To understand the services provided by and the design of an operating system.
2	To understand the structure and organization of the file system.
3	To understand what a process is and how processes are synchronized and scheduled.
4	To understand different approaches to memory management.
5	Students should be able to use system calls for managing processes, memory and the file system.
6	Students should understand the data structures and algorithms used to implement an OS.

[Unit 1]   6 Hrs
Introduction: Evolution of OS, Types of OS, Basic h/w support necessary for modern operating systems, services provided by OS, system programs and system calls, system design and implementation, UNIX system introduction and commands.

[Unit 2]   6 Hrs
Processes and Threads: Process Concept, Process Scheduling, Operations on Processes, Cooperating Processes, Inter process Communication, Communication in Client – Server Systems, Multithreading Models, Threading Issues.
CPU Scheduling: Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Algorithm Evaluation, Process Scheduling Models.

[Unit 3]   6 Hrs
Process Synchronization: Synchronization Background, The Critical-Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Critical Regions, Monitors, OS Synchronization

[Unit 4]   6 Hrs
Deadlocks & Protection: Deadlock definition, Prevention, Avoidance, Detection and recovery, Goals of Protection, access matrix, implementation, Security problem.

[Unit 5]   6 Hrs
Memory Management :   Memory Management Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with Paging, Basics of Virtual Memory – Hardware and

control structures – Locality of reference ,Paging: Principle of operation, Demand Paging, Process Creation, Page Replacement, Allocation of Frames, Thrashing .

[Unit 6]   6 Hrs
File systems: File concept, Access methods, Disk space management and Allocation methods strategies, Directory structures, Recovery, Log-structured File System, Disk arm scheduling strategies**.**
Protection and security: Illustrations of security model of UNIX and other OSs. Examples of attacks.

Textbook:
1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne,   *Operating System Concepts* , Wiley Publication, 8th Edition, 2008.
2. Andrew S. Tanenbaum, *Modern Operating System*, PHI Publication, 4th Edition, 2015
3. Richard Stevens, Stephen Rago, Advanced Programming in the UNIX Environment, Pearson Education, 2/e

Reference Books:
1. D. M. Dhamdhere,   *Systems Programming and Operating Systems*   , McGraw-Hill, 2 nd Edition, 1996.
2. Garry Nutt, *Operating Systems Concepts*, Pearson Publication, 3rd Edition, 2003.
3. Harvey M. Deitel,   *An Introduction to Operating Systems*   , Addison-Wesley Publication, 2 nd Edition, 1990.
4. Thomas W. Doeppner, Operating System in Depth: Design and Programming, Wiley
5. M. J. Bach. Design of the Unix Operating System, Prentice Hall of India, 1986.Publication, 2011.

COURSE OUTCOMES

1	Identify the significance of operating system in computing devices.
2	Exemplify the communication between application programs and hardware devices through system calls
3	Compare and illustrate various process scheduling algoritIhms
4	Apply appropriate memory and file management schemes
5	Illustrate various disk scheduling algorithms.
6	Understand the need of access control and protection in an operating system

Course Title   :   **Web Designing Lab**   Semester   :   **III**
Course Code :   **CS3L006**   Course Type :   **Compulsory**
Pre-requisite :   **Basic Programming**   L – T – P   :   **0– 0– 4**
Stream   :   **Core**   Credits   :   **2**

List of Experiments

1) Designing static web pages using basics and important tags in HTML.

2) Designing dynamic web pages using different cascading style sheets.

3) Design an XML document to store information about a patient in a hospital. Information contains first name, middle name, last name, aadhar no., age, address etc. Create CSS for the above XML document.

4) Write a JavaScript to design a simple calculator to perform various arithmetic operations.

5) Programs using Java servlets and JSP.

6) Designing web applications using PHP.

7) File handling using PHP: Design a page to save the user input details to a text file and display its contents.

8) Write a PHP code to display the number of visitors visiting the web page.

9) Designing web applications in Net Beans Environment.

10) Database Connectivity with MySQL using Java Servlets, JSP, and PHP.

Course Title : **Data structure and Algorithms (Lab)** **Semester** : **III**
Course Code : **CS3L007** **Course Type** : **Compulsory**
Pre-requisite : **C Programming** **L – T – P** : **0 – 0– 2**
Stream : **Core** **Credits** : **1**

List of Experiments:

1. Write a program to implement stack using arrays.
2. Write a program to evaluate a given postfix expression using stacks.
3. Write a program to convert a given infix expression to postfix form using stacks.
4. Write a program to implement circular queue using arrays.
5. Write a program to implement double ended queue (de queue) using arrays.
6. Write a program to implement a stack using two queues such that the push operation runs in constant time and the pop operation runs in linear time.
7. Write a program to implement a stack using two queues such that the push operation runs in linear time and the pop operation runs in constant time.
8. Write a program to implement a queue using two stacks such that the enqueue operation runs in constant time and dequeue operation runs in linear time.
9. Write a program to implement a queue using two stacks such that the enqueue operation runs in linear time and dequeue operation runs in constant time.
10. Write programs to implement the following data structures:
    (a) Single linked list
    (b) Double linked list
11. Implement the following sorting algorithms:
    (a) Insertion sort
    (b) Merge sort
    (c) Quick sort
    (d) Heap sort

Course Title **:** **Operating System (Lab)** **Semester** **:** **III**
Course Code **:** **CS3L008** **Course Type** **:** **Compulsory**
Pre-requisite **:** **CAO and DS** **L – T – P** **:** **0– 0– 2**
Stream **:** **Core** **Credits** **:** **1**

List of Experiments

1. Basics of UNIX commands.
2. Shell programming
3. Implement the various process scheduling mechanisms such as FCFS, SJF, Priority, round- robin.
4. Implement the solution for reader – writer's problem.
5. Implement the solution for dining philosopher's problem.
6. Implement banker's algorithm.
7. Implement the first fit; best fit and worst fit file allocation strategy.
8. File Allocation Strategies Write a C program to simulate the following file allocation strategies.
   a) Sequential   b) Indexed   c) Linked
9. Write a C program to simulate the following contiguous memory allocation techniques
   a) Worst-fit   b) Best-fit   c) First-fit
10. Write a C program to simulate disk scheduling algorithms a) FCFS b) SCAN c) C-SCAN
11. Write a program that uses a wait able timer to stop itself K. Sec. After it started where K is a command line parameter.

4th Semester Computer Engineering

Sr. No.	Category of Subject	Course Code	Course Name	Teaching Scheme			Evaluation Scheme				
				L	T	P	CA	MSE	ESE	Total	Credit
1	PCC	CS4T001	Computer Architecture Organization	3	0	0	20	20	60	100	3
2	PCC	CS4T002	Advanced JAVA	3	0	0	20	20	60	100	3
3	PCC	CS4T003	Wireless Sensor Networks	3	1	0	20	20	60	100	4
4	HSMC	CS4T004	Computer Network	3	0	0	20	20	60	100	3
5	PCC	CS4T005	Database Management Systems	3	1	0	20	20	60	100	4
6	PCC	CS4L006	Advanced JAVA(Lab)	0	0	4	40	0	60	100	2
7	PCC	CS4L007	Wireless Sensor Networks(Lab)	0	0	2	40	0	60	100	1
8	PCC	CS4L008	DBMS(Lab)	0	0	2	40	0	60	100	1
				13	2	8	220	100	480	800	21

Course Title : Computer Architecture Organization   **Semester** : **IV**
Course Code : CS4T001   **Course Type** : **Compulsory**
Pre-requisite : Digital Electronics Circuits   **L – T – P** : **3 – 0– 0**
Stream : Core   **Credits** : **3**

COURSE OBJECTIVES

1	To understand the relationship between instruction set architecture, architecture, and system architecture and their roles in the development of the computer.
2	To be aware of the various classes of instruction: data movement, arithmetic, logical and flow control. Explain how interrupts are used to implement I/O control and data transfers.
3	To Understand how a CPU's control unit interprets a machine –level instructions.
4	To Identify various types of buses in Computer systems.
5	To Understand memory hierarchy.
6	To Understand various peripheral devices.

[Unit 1]   6 Hrs
Basic Structure of Computer: Hardware & Software, Addressing Methods, Program Sequencing, Concept of Memory Locations & Address, Main Memory Operation, Instructions & Instruction Sequencing, Number representation, Design of Fast Adders, Signed Addition and Subtraction. Multiplication of Positive numbers, Floating-Point Numbers and related operations Basic I/O Operations, Stacks, Queues & Subroutines.

[Unit 2]   6 Hrs
Processing Unit: Fundamental Concepts, Execution of a Complete Instruction, Hardwired Control, Performance Consideration, Micro-programmed Control, Microinstructions, Micro-program Sequencing, Microinstruction Pre-fetching, Emulation., Booth's Algorithm, Integer Division.

[Unit 3]   6 Hrs
I/O Organization: Accessing I/O Devices, Interrupts, Addressing Modes, Direct Memory Access, Bus arbitration, I/O Hardware, Processor Bus and Interfacing Circuits, Standard I/O Interfaces, SCSI Bus, Backplane Bus Standard.

[Unit 4]   6 Hrs

Memory Unit: Basic Concepts, Semiconductor RAM Memories, Internal Organization, Static & Dynamic RAMs, ROMs, Speed, Size & Cost Considerations. Cache Memories: Performance considerations. Virtual Memories, Address Translation, Memory Management Requirements.

[Unit 5]   6 Hrs
Arithmetic: RISC philosophy, pipelining, basic concepts in pipelining, delayed branch, branch prediction, data dependency, influence of pipelining on instruction set design, multiple execution units, performance considerations.

[Unit 6]   6 Hrs
Computer Peripherals: Input-Output Devices like Video displays, Video terminals, Graphics input devices, Printers. Online storage devices: Magnetic disks, Magnetic tape, Systems, CD-ROM systems. Communication devices: Modems.

Text-Book:

1.   V. Carl Hamacher & S. Zaky: Computer Organization, Fourth Edition, McGraw-Hill (ISE).

References:

1. Stallings. W: Computer Organization & Arcitecture, Fifth Edition, Pearson Education.
2. Tananbaum A. S: Structured Computer Organization, Fifth Edition, Pearson Education.
3. Hayes J. P: Computer Architecture & Organization, Fourth Edition, McGraw- Hill.
4. M. Mano & Kime Logie: Computer Design Fundamentals, Second Edition, Pearson Education.

COURSE OUTCOMES
Student shall be able to

1	Describe the fundamental organisation of a computer system
2	Interpret the functional architecture of computing systems. (Understanding)
3	Explain addressing modes, instruction formats and program control statements
4	Distinguishtheorganizationofvariouspartsofasystemmemoryhierarchy
5	Describe basic concept of parallel computing and Describe fundamentals concepts of pipeline and vector processing
6	Identify, compare and assess issues related to ISA, memory, control and I/O functions. (Applying, Analyzing, Evaluating)

Course Title : Advanced JAVA   **Semester**   :   **IV**

Course Code : CS4T002   **Course Type** :   **Compulsory**

Pre-requisite : basic C, C++ and some   **L – T – P**   :   **3 – 0– 0**
                 basic concepts of Core Java

Stream   : **Core**   **Credits**   :   **3**

COURSE OBJECTIVES

1	To learn the Advanced concepts in J2SE
2	To understand Web Application Development, Database Connectivity and its Implementation using Servlets, JSP and JDBC
3	To introduce advanced Java frameworks for improving the web application design.

[Unit 1]   **6 Hrs**
Introduction to Java Programming : Overview of Java, Fundamental Programming Structures, Strings – Objects Classes and Methods - Inheritance - Packages and Interfaces - Exception handling, Collections - Multithreading – Java I/O Streams, File Handling.

Exploring Core Java :   Applets , Java GUI Programming and Event Handling, Java Networking, RMI, Reflection, Collections, Generics, Java Auto boxing and Annotations.

[Unit 2]   **6 Hrs**
Java Networking : Network Basics and Socket overview, TCP/IP client sockets, URL, TCP/IP server sockets, Datagrams, java.net package Socket, ServerSocket, InetAddress, URL, URL Connection. Introducing JavaEE, Enterprise Java, Basic Application Structure, Using Web Containers, Creating Servlets, Configuring Servlets, Understanding HTTP methods, Using Parameters and Accepting Form Submissions, Using Init parameters, File Uploading, JDBC.

[Unit 3]   **6 Hrs**
JDBC Programming :   The JDBC Connectivity Model, Database Programming: Connecting to the Database, Creating a SQL Query, Getting the Results, Updating Database Data, Error Checking and the SQLException Class, The SQL Warning Class, The Statement Interface, Prepared Statement , CallableStatement The Result Set Interface, Updatable Result Sets, JDBC Types, Executing SQL Queries, ResultSet MetaData, Executing SQL Updates, Transaction Management.

[Unit 4]   **6 Hrs**

Servlet API and Overview : Servlet Model, Overview of Servlet, Servlet Life Cycle, HTTP Methods Structure and Deployment descriptor ServletContext and ServletConfig interface, Attributes in Servelt, Request Dispacher interface The Filter API: Filter, FilterChain, Filter Config Cookies and Session Management: Understanding state and session, Understanding Session Timeout and Session Tracking, URL Rewriting.

[Unit 5]   6 Hrs
Java Server Faces2.0 : Introduction to JSF, JSF request processing Life cycle, JSF Expression Language, JSF Standard Component, JSF Facelets Tag, JSF Convertor Tag, JSF Validation Tag, JSF Event Handling and Database Access, JSF Libraries: PrimeFaces.
EJB: Enterprise bean architecture, Benefits of enterprise bean, types of beans, Accessing beans, packaging beans.

[Unit 6]   6 Hrs
Hibernate 4.0: Overview of Hibernate, Hibernate Architecture, Hibernate Mapping Types, Hibernate O/R Mapping, Hibernate Annotation, Hibernate Query Language.
Java Web Frameworks: Spring MVC, Overview of Spring, Spring Architecture, bean life cycle, XML Configuration on Spring, Aspect – oriented Spring, Managing Database, Managing Transaction.

Textbook:

1) Herbert Schildt, The Complete Reference-Java, Tata Mcgraw-Hill Edition, Eighth Edition, 2014.
2) Nicholas S. Williams, Professional Java for Web Applications, Wrox Press, 2014.
3) Complete Reference J2EE by James Keogh mcgraw publication.

Reference Books:

1) Black Book " Java server programming" J2EE, 1st ed., Dream Tech Publishers, 2008. 3. Kathy walrath .
2) Core Java, Volume II: Advanced Features by Cay Horstmann and Gary Cornell Pearson Publication.
3) Spring in Action 3rd edition , Craig walls, Manning Publication.
4) Hibernate 2nd edition, Jeff Linwood and Dave Minter, Beginning Après publication.

COURSE OUTCOMES

1	Student shall be able to Understand and implement advanced Java concepts.
2	Student shall be able to Develop Java based Web applications using Servlets and JSP
3	Student shall be able to Incorporate cutting-edge frameworks in web application development.

Course Title : Wireless Sensor Networks   **Semester** : IV

Course Code : CS4T003   **Course Type** : Compulsory

Pre-requisite : Nil   **L – T – P** : 3 – 1– 0

Stream : Core   **Credits** : 4

Suggestions : Exposure to the fundamentals of next generation sensor network platforms and applications including cyber-physical systems, healthcare, smart city and Internet of Things(IoT).

ii) Design of energy efficient MAC protocols for Wireless Sensor Networks in IoT environment

iii) Development of routing and fusion algorithms for efficient dissemination of sensor data and service discovery in next generation networks.

[Unit 1]   **6 Hrs**
Introduction: Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Mobile AdhocNETworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor   **NetworksSensor Node Hardware and Network Architecture:**   Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC,
Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.

[Unit 2]   **6 Hrs**
Deployment and Configuration: Localization and positioning, Coverage and connectivity, Single-hop and multihop localization, self-configuring localization systems, sensor management.
Network Protocols :   Issues in designing MAC protocol for WSNs, Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and Zig Bee, Dissemination protocol for large sensor network.
Routing protocols: Issues in designing routing protocols, Classification of routing protocols, Energy-efficient routing, Unicast, Broadcast and multicast, Geographic routing.

[Unit 3]   **6 Hrs**
Data Storage and Manipulation: Data centric and content based routing, storage and retrieval in network, compression technologies for WSN, Data aggregation technique.
Applications: Detecting unauthorized activity using a sensor network, WSN for Habitat Monitoring.

[Unit 4]   **6 Hrs**

Routing in WSN: Data dissemination and gathering, Routing challenges and design issues in WSN, Routing strategies, Flooding and it's variants, Low energy adaptive clustering, Geographical routing .

[Unit 5]   6 Hrs
Transport Protocol: Traditional transport protocol, Transport protocol design, Authenticity: Message authentication code, Signature, Authenticating public key, Broadcast and Multicast authentication.

[Unit 6]   6 Hrs
Network Management and Operating System for WSN: Traditional network management models, network management design issues, Example of management architecture: MANNA, Operating system design issues, Operating System: Tiny OS, Mate OS, Magnet OS.

Suggestions:

i) Exposure to the fundamentals of next generation sensor network platforms and applications including healthcare, smart city and Internet of Things(IoT).

ii) Design of energy efficient MAC protocols for Wireless Sensor Networks in IoT environment

iii) Development of routing and fusion algorithms for efficient dissemination of sensor data and service discovery in next generation networks.

Textbook:

1. HolgerKerl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Network", John Wiley and Sons, 2005 (ISBN: 978-0-470-09511-9)
2.   Raghavendra, Cauligi S, Sivalingam, Krishna M., ZantiTaieb, "Wireless Sensor Network", Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).
3.   Feng Zhao, Leonidas Guibas, " Wireless Sensor Network",Elsevier, 1st Ed. 2004 (ISBN: 13-978-1-55860-914-3).

Reference Book:

1. Kazem, Sohraby, Daniel Minoli, TaiebZanti, "Wireless Sensor Network: Technology, Protocols and Application", John Wiley and Sons 1st Ed., 2007 (ISBN: 978-0-471-74300-2).
2.   B. Krishnamachari, " Networking Wireless Sensors", Cambridge University Press**.**

Course Title : Computer Network   **Semester** : IV
Course Code : CS4T004   **Course Type** : Compulsory
Pre-requisite : CAO, DC   **L – T – P** : 3 – 0– 0
Stream : Core   **Credits** : 3

COURSE OBJECTIVES

1	Acquire the computer networking knowledge as well as the existing connectivity technologies and the required infrastructure which comprises the key steps involved in the communication process.
2	Identify the key issues for the realization of the LAN/WAN/MAN network
3	Establish a solid knowledge of the layered approach that makes design, implementation and operation of extensive networks possible. To learn the 7-layer OSI network model (each layer and its responsibilities) and understand the TCP/IP suite of protocols and the networked applications supported by it.
4	Establish a solid knowledge of the layered approach that makes design, implementation, and operation of extensive networks possible.
5	Acquire the knowledge of the basic protocols involved in wired/wireless communication process
6	Acquire the computer networking knowledge as well as the existing connectivity technologies and the required infrastructure which comprises the key steps involved in the communication process.

[Unit 1]   6 Hrs
Data and Signal: Define data, signal. Time domain and frequency domain representation of signal, bandwidth of a signal and medium, Sources of impairment, Attenuation, distortion, noise, data rate Limits and Nyquist bit rate, FDM and TDM, synchronous and asynchronous TDM.

[Unit 2]   6 Hrs
Introduction of LAN; MAN; WAN; PAN, Ad-hoc Network, Network Architectures: Client-Server; Peer to Peer; OSI Model, TCP/IP Model, Topologies, Data Link Layer: Data Link Layer Design Issues: Service provided to network layer Framing, Error Control, Flow Control, Error Detection and Correction, Data Link Control, Multiple Access.

[Unit 3]   6 Hrs
Network Layer: Design issues, store and forward packet switching connection less and connection oriented networks-routing algorithms-optimality principle, shortest path, flooding, Distance Vector Routing, Control to Infinity Problem, Hierarchical Routing, Congestion control algorithms.

[Unit 4]   6 Hrs
Transport Layer: UDP, TCP, Connection establishment and termination, sliding window revisited, flow and congestion control, timers, retransmission, TCP extensions, etc.

[Unit 5]   6 Hrs
Application Layer: Application protocols for email, ftp, web, DNS

[Unit 6]   6 Hrs
Advanced Networking: overview to network management systems; security threats and solutions – Firewalls, Access Control Lists, IPSec, IDS

Textbook:
1. Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.
2. Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.
3. Kurose and Ross, "Computer Networking - A top-down approach", Seventh Edition, Pearson, 2017.
4. Peterson and Davie, "Computer Networks, A Systems Approach'', 5th ed., Elsevier, 2011.

Reference Book:
1. An Engineering Approach to Computer Networks - S. Keshav, 2nd Edition, Pearson Education.
2. Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning**.**

COURSE OUTCOMES

1	Defining, using and implementing Computer Networks and the basic components of a Network system, explain the importance of data communications, how communication works in data networks.
2	Evaluate data communication link considering elementary concepts of data link layer protocols for error detection and correction.
3	Apply various network layer techniques for designing subnets and supernets and analyse packet flow on basis of routing protocols.
4	Estimate the congestion control mechanism to improve quality of service of networking application
5	Analyze the features and operations of various application layer protocols such as Http, DNS, Telnet, FTP and SMTP.

Course Title   : Database Management Systems   Semester   :   IV
Course Code   : CS4T005   Course Type   :   Compulsory
Pre-requisite : Data Structure and Algorithms   L – T – P   :   3 – 1– 0
Stream   :Core   Credits   :   4

COURSE OBJECTIVES

1	To Eliminate redundant data.
2	To Make access to the data easy for the user.
3	To Provide for mass storage of relevant data.
4	To Make the latest modifications to the data base available immediately.
5	To Protect data from physical harm and un-authorised systems.
6	To Allow multiple users to be active at one time.

[Unit 1]   6 Hrs
Introduction to Database Systems: Significance and advantages, Types of Databases, Limitations of File processing system, the DBMS Environment,   Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).
Data models: Evolution of Data Models,   Entity-relationship model, Relational integrity constraints, data manipulation operations.

[Unit 2]   6 Hrs
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.

[Unit 3]   6 Hrs
Relational database design: Normalization of Database Tables: Need and Significance,   Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design.

[Unit 4]   6 Hrs
Query processing: Evaluation of relational algebra expressions, Query equivalence, Join strategies.

[Unit 5]   6 Hrs
File Organization and Indexing: Indices, B-trees, hashing.

[Unit 6]   6 Hrs
Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

Text Books:
1. Henry Korth, Abraham Silberschatz & S. Sudarshan, *Database System Concepts*, McGraw-Hill Publication, 6th Edition, 2011.
2. Bipin Desai, An Introduction to Database System, West Publishing Company, College & School Division, 1990.
3. Raghu Ramakrishnan, Johannes Gehrke, *Database Management Systems*, McGraw-Hill Publication, 3rd Edition, 2003.

Reference Books:
1. Joel Murach, *Murach's Oracle SQL and PL/SQL for Developers,* Mike Murach & Associates, 2nd Edition, 2014.
2. Wiederhold, *Database Design*, McGraw-Hill Publication, 2nd Edition, 1983.
3. Navathe, *Fundamentals of Database System*, Addison-Wesley Publication, 6th Edition, 2012.
4. J. D. Ullman, "Principles of Database and Knowledge – Base Systems", Vol 1, Computer Science Press.

COURSE OUTCOMES

1	Student shall be able to learn and understand fundamentals of database management system
2	Student shall be able to exhibit the query development knowledge
3	Student shall be able to learn modeling and normalization of databases.
4	Student shall be able to learn query processing and optimization techniques.
5	Students shall be able to exhibit to File Organization, Indexing and Hashing
6	Student shall be able to exhibit the knowledge of transaction and concurrency control.

Course Title : Advanced JAVA (Lab)   **Semester**   :   **IV**
Course Code : CS4T006   **Course Type**   :   **Compulsory**
Pre-requisite : basic C, C++ and some   **L – T – P**   :   **0 – 0– 4**
                    basic concepts of Core Java
Stream   : **Core**   **Credits**   :   **2**

List of Experiments

1. Write a Servlet to display "Hello World" on browser.
2. Assume that the information regarding the marks for all the subjects of a student in the last exam are available in a database, Develop a Servlet which takes the enrolment number of a student as a request parameter and displays the mark sheet for the student.
3. Develop a Servlet which looks for cookies for username and password, and forwards to a home.jsp in case the cookies are valid and forwards to login.jsp, in case the cookies are not found or the cookies are not valid.
4. Develop a Servlet to authenticate a user, where the login id and password are available as request parameters. In case the authentication is successful, it should setup a new session and store the user's information in the session before forwarding to home.jsp, which displays the user's information like full name, address, etc.
5. Create Servlet file which contains following functions:
        1. Connect
        2. Create Database
        3. Create Table
        4. Insert Records into respective table
        5. Update records of particular table of database
         6. Delete Records from table.
        7. Delete table and also database

6. User can create a new database and also create new table under that database. Once database has been created then user can perform database operation by calling above functions. Use following Java Statement interface to implement program:
    a) Prepared Statement
    b) Callable statement

7.   Study and implement Hibernate.
8.   Study and Implement MVC using Spring Framework.

Course Title   : Wireless Sensor Network (Lab)   Semester   :   IV
Course Code   : CS4L007   Course Type   :   Compulsory
Pre-requisite : Nil   L – T – P   :   0 – 0– 2
Stream   :Core   Credits   :   1

List of Experiments

1.   Introduction of Wireless sensor network applications and its simulation.

2.   Network Simulator installation of wireless sensor network.

3.   Write TCL script for transmission between mobile nodes.

4.   Write TCL script for sensor nodes with different parameters.

5.   Generate TCL script for udp and CBR traffic in WSN nodes.

6.   Generate TCL script for TCP and CBR traffic in WSN nodes.

7.   Implementation of routing protocol in NS2 for AODV protocol.

8.   Implementation of routing protocol in NS2 for DSR protocol.

9.   Implementation of routing protocol in NS2 for TORA protocol.

10. Study other wireless sensor network simulators.

Course Title   : Database Management Systems (Lab)   **Semester**   :   **IV**
Course Code   : CS4L008   **Course Type**   :   **Compulsory**
Pre-requisite : Data Structure and algorithms   **L – T – P**   :   **0 – 0– 2**
Stream   :Core   **Credits**   :   **1**

List of Experiments

1. Defining schema for applications.
2. Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3. Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4. Sub-queries, Set operations, Joins.
5. Creation of databases, writing SQL and PL/SQL queries to retrieve information from the databases.
6. Assignment on Triggers & Cursors.
7. Normal Forms: First, Second, Third and Boyce Codd Normal Forms.
8. Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management.
9. Deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project.
10. Large objects – CLOB, NCLOB, BLOB and BFILE.
11. Distributed data base Management, creating web-page interfaces for database applications using servlet.