GANGADHAR MEHER UNIVERSITY
AMRUTA VIHAR,SAMBALPUR,ODISHA

SCHOOL OF COMPUTER SCIENCE

Syllabus for

M.Sc. in Computer Science

(2-Year Programme)

Course Effective from Academic Year 2022-2023

SCHOOL OF COMPUTER SCIENCE

Vision

To create globally competent undergraduates and postgraduates in Computer Science by imparting training in emerging technologies and collaborative research through a conducive and disciplined academic environment, and orient them towards serving the society.

Mission Statements

M1: To provide high quality professional training at the undergraduate and postgraduate level with an emphasis on basic principles of computer science.

M2: To empower the students with the required skills to solve the complex technological problems of modern society and also provide them with a framework for promoting collaborative and multidisciplinary research.

M3: To strengthen the Industry-Academia interface by interacting with the industry, educational & research organizations and alumni that will help the students to emerge as leaders in academics or in entrepreneurship.

M4: To impart moral and ethical values, and interpersonal skills to the students for betterment of the society.

PROGRAM OUTCOMES(POs):

PO1. **Knowledge and Understanding**: Develop an ability to understand the theoretical foundations of computer science for designing efficient methodologies along with the knowledge of limitations of computing.

PO2. **General, Technical and Professional Skills:** An ability to function effectively as an individual with diversified skills or as a part of a multi-disciplinary team setting to accomplish defined goals.

PO3. **Application of Knowledge and Skills**: Developing problem analysis skills and knowledge and applying the same in real life situation.

PO4. **Research Skills:** Explore research based knowledge and carry out academic investigations on the cutting edge technologies in allied subjects of Computer Science.

PO5. **General Learning Outcomes:** Create, select and apply advanced techniques and tools including modelling complex activities related to Computer Science.

PO6. **Constitutional, Humanistic, Ethical and Moral Values:** Design, develop and evaluate new system components or processes of computer science that meet the desired needs with appropriate considerations of industry, society, public health, safety, culture, environment and sustainable development sticking on to the ethics and values.

PO7: **Employability Job Skills and Entrepreneur Skills:** Prepare the students to take up a career as versatile contributors in industry, academia, research and development or entrepreneurship employing their expertise to advance personal growth while making meaningful contributions to societal progress

PROGRAM SPECIFIC OUTCOMES(PSOs):

PSO1. To shield students from the rapid obsolescence of computer technology, the program focuses on imparting foundational knowledge, fostering critical thinking skills, and cultivating technical expertise.

PSO2. Apply principles of computer science theory and concepts of software development to create effective computing-based solutions.

PSO3. Empowering the students to function as adept computer science professionals across various domains, including industry, advanced studies, research and development, academia, or entrepreneurship.

Post Graduate
Programme Structure

Year	Semesters	
First Year	Semester I	Semester II
Second Year	Semester III	Semester IV

Part-I: Semester-I

Papers		Duration (Hrs)	Credit
Paper No	Title		
CSC101	Advanced Operating Systems	4	4
CSC102	Computer Architecture	4	4
CSC103	Data Communication and Networks	4	4
CSC104	Advanced Data Structures	4	4
CSC105	Lab I (Data Structure and Operating System)	6	4
Total			**20**

Part-I: Semester-II

Papers		Duration (Hrs)	Credit
Paper No	Title		
CSC201	Object Oriented Programming	4	4
CSC202	Mobile Computing	4	4
CSC203	Discrete Mathematical Structures	4	4
CSC204	Theory of Computation	4	4
CSC205	Lab II (OOP using Java and TOC)	6	4
	DSE-I Papers		
CSC206 A	**Data Warehousing and Mining**	4	4
CSC206 B	**Wireless Sensor Networks**	4	4
CSC206 C	**Internet of Things**	4	4
CSC206D	**Microprocessor and Microcontroller**	4	4
Total			**24**

Part-II: Semester-III

Papers		Duration (Hrs)	Credit
Paper No	Title		
CSC301	Compiler Construction	4	4
CSC302	Database Management Systems	4	4
CSC303	Design and Analysis of Algorithms	4	4
	DSE-II Papers		
CSC304A	**Data Science**	4	4
CSC304B	**Web Technology**	4	4
CSC304C	**Information Security**	4	4
CSC304D	**Digital Image Processing**	4	4
CSC305	Lab III (Algorithms and DBMS)	6	4
IDSE Papers			
CSC306A	**Network and Internet Technologies**	4	4
CSC306B	**Fundamentals of Computer**	4	4
CSC306C	**Introduction to Programming Using Python**	4	4
CSC306D	**Artificial Intelligence**	4	4
Total			**24**

Part-II: Semester-IV

Papers		Duration(Hrs)	Credit
Paper No	Title		
CSC401	Machine Learning	4	4
CSC402	Software Engineering and OOAD	4	4
CSC403	Cloud Computing	4	4
CSC404	Project Work Report and VIVA VOCE		8
	MOOCs-1		6
	MOOCs-2		
Total			**20+6***
	Grand Total		**88+6***

*Non-Divisional Credits

SEMESTER WISE CREDIT DISTRIBUTION					
Semester	**I**	**II**	**III**	**IV**	**TOTAL**
Total Credit	**20**	**24**	**24**	**20+6***	**88+6***

NB:

- The students are encouraged to take two extra MOOCs courses to earn a maximum of 6 Credits.
- Each theory paper consists of 100 marks(Mid Sem 20,End Sem 80).
- Lab Exam will be of 100 marks.

Semester-I

Course Code	**CSC101**
Course Name	**ADVANCED OPERATING SYSTEMS**
Category	Programme Core Course
Prerequisite	Computer Programming and Data Structures Computer Organization and Architecture

Paper-CSC101

Advanced Operating Systems

UNIT-I: 10 hrs

Operating System Overview: -Introduction, The Need of Operating Systems, Evolution of Operating Systems, Types of Operating Systems, Simple Batch, Multiprogrammed, Time-shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, System components, Operating System services, System Calls, Virtual Machines, System Design and Implementation.
Process Management – Process concepts, Life cycle, PCB, Schedulers, Process Scheduling, Threads, Scheduling Levels, CPU Scheduling: Scheduling-Criteria, Algorithms, Algorithm Evaluation.

UNIT-II: 10hrs

Concurrency:-Process synchronization, The Critical- Section Problem, Peterson's Solution, synchronization Hardware, Semaphores, Classic problems of synchronization, Monitors.
Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock detection, deadlock prevention, deadlock avoidance, Recovery from deadlock.

UNIT-III: 10hrs

Memory Management: Main Memory, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table.
Virtual Memory: Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files

UNIT-IV: 10hrs

Mass-Storage Structure: Overview, Disk Structure, Disk scheduling, disk management, Swap-space management, RAID structure.
File Systems: File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, Protection. File- System Structure and Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

Text Book:

1. A. Silberchatz, P. B. Galvin, G. Gagne, Operating System Concepts, 8th Edition, Wiley India,2010.

Reference Books:

1. Charles Crowley,Operating Systems : A Design-Oriented Approach, 1st Edition, McGraw-Hill,1996.
2. A. S. Tanenbaum and H. Bos, Modern Operating Systems, 4th Edition, Pearson,2015.
3. W. Stallings, Operating Systems – Internals And Design Principles, 9thEdition, Prentice Hall,2017.
4. D. M. Dhandhere,Operating Systems-A Concept Based Approach, 2ndEdition, McGraw-Hill,2006

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Explain the different types of Operating systems.
CO2	Describe the lifecycle of a process and its attributes with its scheduling algorithms.
CO3	Analyze the concept of Deadlock.
CO4	Apply segmentation and paging techniques.
CO5	Explain the structure and organization of the file systems and I/O systems

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3		1		1			1	1	1
CO2	3		3		3			3	3	3
CO3	3		3		3			3	3	3
CO4	3		3		3			3	3	3
CO5	3		3		3			3	3	3

Course Code	**CSC102**
Course Name	**COMPUTER ARCHITECTURE**
Category	Programme Core Course
Prerequisite	Digital Logic

Paper-CSC102

Computer Architecture

UNIT :I **8hrs**

Register Transfer and Micro-operations :

Register transfer language, Register transfer, Bus and Memory transfer, Arithmetic, Logical and Shift micro-operations, Arithmetic Logic Shift unit.

Basic Computer Organisation and Design:

Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle & Register Reference Instructions, Memory Reference Instructions, Input-Output and Interrupt , Design of Basic Computer.

UNIT:II **8hrs**

Basic Processing Unit:

Some fundamental concepts, Register Transfers, Performing an Arithmetic or Logic operation, Fetching a word from memory, storing a word in memory, Execution of a complete instruction, Branch instructions, multiple Bus Organization.

Micro-Programmed Control:

Control memory, Addressing sequencing: Conditional branching, Mapping of Instruction, Subroutine; Micro Program example: Computer configuration, Micro-instruction format, Symbolic Micro-instruction, the fetch routine, Symbolic Micro-program, Binary micro-instruction; design of control unit: Micro program sequencer.

UNIT:III **12hrs**

Memory Organization:

Memory Hierarchy, Associative Memory: Hardware organization, Match Logic, Read operation., write operation, cache memory: Associative mapping, Direct mapping, Set Associative mapping, write into cache memory, cache initialization, virtual memory: Address space and memory Space, Address mapping using pages, Associative Memory Page table, Page Replacement.

UNIT: IV **12hrs**

Pipeline and Vector Processing :

Parallel Processing, Pipelining: General Considerations; Arithmetic Pipeline, Instruction Pipeline: four segment Instruction Pipeline Example, Data Dependency, Handling of Branch Instructions; Vector Processing : Array Processors.

Multiprocessors:

Characteristics of Multiprocessors, Interconnection structures, Inter-processor arbitration. Inter-processor communication and synchronization , cache coherence.

Text Book:

1. William Stalling**,**Computer Organization andArchitecture,10th Edition ,PHI.

Reference Books:
1. Rajiv Chopra ,Computer Architecture and Organization,1st Edition,S.Chand,2014.
2. Carl Hamacher, Zvonkoranesic, SafwatZaky,Computer Organization,5th Edition,McGrw-Hill Education India

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Explain the register transfer inside the computer along with the associate micro operations and reference instructions .
CO2	Explain the processing unit with the micro-programmed control working.
CO3	Describe the memory organization with the virtual memory concept along with the mapping and replacement technique.
CO4	State the pipeline concept with the relative example and with working of vector processor.
CO5	Solve the complexity of the system related to mapping and replacement.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	3	2	1	3		2	2	1	3
CO2	3	3	3	1	2				2	
CO3	1	3	2	2	2	1		2		3
CO4	2	3	2	2	2		3	1	1	1
CO5	2	3	3	2	1	2			3	

Course Code	**CSC103**
Course Name	**DATA COMMUNICATION AND NETWORKS**
Category	Programme Core Course
Prerequisite	Basics of Computers

Paper-CSC103

Data Communication and Networks

UNIT :I **12hrs**

Overview of Data Communication and Networking. **Physical Layer:** Analog and Digital, Analog Signals, Digital signals, Analog versus Digital, Data Rate Limits, Transmission Impairment, More about signals, **Digital Transmission:** Line coding, Block coding, Sampling, Transmission mode, Analog Transmission : Modulation of Digital Data; Telephone modems, modulation of Analog signals, Multiplexing : FDM, WDM, TDM, Transmission media: Guided media, unguided media (wireless), Circuit switching and Telephone Network: Circuit switching, Telephone network.

UNIT:II **14hrs**

Data Link Layer: Error Detection and Correction: Types of errors, Detection, Error correction, Data Link control and Protocols: Flow and Error control, Stop-and-Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to-Point Protocol, Multiple Access, Random Access, Controlled Access, Channelization. Local area Network: Ethernet, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LANs : IEEE 802.11, Bluetooth virtual circuits: Frame Relay and ATM.

UNIT:III **10hrs**

Network Layer: Host- to –Host Delivery: Internetworking, Addressing, Routing, Network Layer Protocols: ARP, RARP, NAT, BOOTP, DHCP, IPV4, IPV6, ICMP, ICMPV6 and Unicast Routing protocols, Transport Layer: Process to Process Delivery: UDP, TCP, congestion control and Quality of Service.

UNIT: IV **04hrs**

Application Layer: Client Server Model, Peer to Peer network, Domain Network System (DNS), Electronic Mail (SMTP), and file transfer (FTP), HTTP and WWW.

Text Books:

1. B.A. Forouzan, Data Communication and Networking, 6th Edition, Tata McGraw Hill ,2007.
2. Peter Lars Dordal, An Introduction to Computer Networks, 2nd Edition , Loyola University of Chicago

Reference Books:

1.A.S.Tenenbaum, Computer Network, 5thEdition, PHI.
2.James F. Kurose &Keith W.Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 8th Edition, Pearson Education India

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Understand the properties of digital and analog signals, functionality of different layers in OSI and TCP/IP network models and the factors which impact performance of data communication systems
CO2	Understand the analog and digital transmission, properties of communication medias,and the concept of multiplexing of data on common communication channel.
CO3	Understand different switching circuits, link layer addressing and exemplifythe different coding methods and error detection and correction methods for digital data.
CO4	Identify and describe the system functions in the correct protocol layer and further describe how the layers interact
CO5	Basic understanding of working of different protocols in various layers.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PS1**	**PS2**	**PS3**
CO1	2	2	2	1	3	1	2	2	1	1
CO2	2	2	2	1	3	1	2	2	2	2
CO3	3	3	3	1	3	1	3	2	3	2
CO4	3	2	1	1	3	1	2	2	2	1
CO5	3	2	3	2	2	1	2	2	2	2

Course Code	**CSC104**
Course Name	**ADVANCED DATA STRUCTURES**
Category	Programme Core Course
Prerequisite	Elementary Mathematics and C Programming Language

Paper-CSC104

Advanced Data Structures

UNIT-I: **12hrs**

Introduction to Data Structures, Arrays and Strings, Introduction to Algorithms, Algorithm development, Complexity analysis, Recursion.
Linear Data Structures: Stacks: Operations and Applications, Queues: Operations and Applications, Circular Queues: Operations and Applications.
Linked Lists: Operation – Creations, insertion, Deletion, Circular Lists, and Doubly Linked List.

UNIT-II: **8hrs**

Sorting: Insertion Sort, Merge Sort, Quick Sort, Radix Sort, and Heap Sort.
Searching: Binary Search, Selection.
Dictionaries: skip-lists, hashing, analysis of collision resolution techniques.

UNIT-III: **10hrs**

Search Trees- Binary search Trees, Threaded binary tree, AVL Trees, B Trees, Red Black trees. Searching, insertion, deletion operations of trees.
Tries and pattern matching: Priority queues and binary heaps

UNIT-IV: **10hrs**

Introduction to Graphs: Breadth first search and connected components. Depth first search in directed and undirected graphs and strongly connected components.
Spanning trees: Prim's and Kruskal's algorithm, union-find data structure. Dijkstra's algorithm for shortest path. Shortest path tree. Shortest and longest paths in directed acyclic graphs.Automatic List management, dynamic storage management.

Text Book:

1. Y. Langsam, M. Augenstein, A. M. Tenenbaum, Data Structure using C and C++, Prentice Hall, 1996.

Reference Books:

1. E. Horowitz, D. Mehta, S. Sahani. Fundamentals of Data Structures in C++, Universities Press. 2007.
2. M. A. Weiss, Data Structures and Algorithm Analysis in C++,PearsonEducation 2006.
3. M. T. Goodrich, R. Tamassia, D. Mount, Data Structures and Algorithms in C++, Wiley India Pvt. Ltd, 2004

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Analyse performance of algorithms and apply basic data structures stack and queue to solve real world problems.
CO2	Employ linked list to implement different ADTs and apply it in solving some problems.
CO3	Examine various sorting algorithms and outline different hashing techniques.
CO4	Describe hierarchical data structures and use it in real life applications.
CO5	Explain graph data structures and apply graph related algorithms in real world scenarios.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1			3		1		3	3	3	3
CO2	3		3		2		3	3	3	3
CO3	3		3		1		3	3	3	3
CO4	3		3		3		3	3	3	3
CO5	3		3		3		3	3	3	3

Paper-CSC105

Lab I:Data Structure and Operating Systems

DATA STRUCTURE PROGRAMS:

1. Implementation of sparse matrix
2. Implementation of linear search, binary search, bubble sort, insertion sort, selection sort
3. Implementation of single linked list and its operations
4. Design a doubly linked list to hold strings and use it for organizing a sequence of cities
5. Repeat Q4 using doubly circular linked list
6. Create a polynomial using single linked list and perform addition operation of two polynomials
7. Implement a stack,use stack for conversion of infix to postfix and evaluation of postfix expression.
8. Implementation of circular queue (using array) with menu options like insert, delete,display and exit.
9. Implementation of a priority queue and use it to organize studentrecords prioritized by marks.
10. Recursive implementation of quick sort and merge sort. Generate 10 random integers in a given range and apply sorting mechanisms.
11. Implement linear search and binary search to find out whether a given element is present or not in the array. Compare two search mechanisms based on number of comparisons required for a successful as well as unsuccessful search.
12. Implementation of a binary search tree with menu options: Construct a tree, insertanode, delete anode, traverse and display preorder, in order and post order sequenceof its nodes.
13. Implementation of Heap Sort.
14. Implementation of digraphs using adjacency matrix and find the transitive closureusingWarshall's algorithm.
15. Implementation of a weighted graph and find minimal cost spanning tree usingPrim's algorithm.
16. Implementation of a weighted graph and find minimal cost spanning tree using Kruskal's algorithm.
17. Implement Dijkstra's algorithm to find single source shortest path.
18. Implement Floyd Warshall's algorithm to find all pair shortest path.
19. Implement Topological sorting.
20. Implementation of a small Real World Application illustrating data structure usage.

OPERATING SYSTEM PROGRAMS:

1. Implementation of FCFS Scheduling.
2. Implementation of Round Robin Scheduling.
3. Implementation of Shortest Job First Scheduling (Non Pre-emptive).
4. Implementation of Shortest Job First Scheduling (Pre-emptive).
5. Implementation of Priority Based Scheduling.
6. Implementation of Deadlock detection
7. Implementation of simple Thread and Multi-Threading.
8. Implementation of Paging techniques of Memory Management(FIFO,LRU,OPTIMAL).
9. Implementation of Semaphore.
10. Implementation of Peterson's Solution in Process Synchronization.

Semester-II

Course Code	**CSC201**
Course Name	**OBJECT ORIENTED PROGRAMMING**
Category	Programme Core Course
Prerequisite	Basic procedural programming Language (like C-Programming)

Paper-CSC201	
Object Oriented Programming	
UNIT-I:	**8hrs**
Java Evolution and Environment: Java evolution, overview of java language, java history, features of java, how java differs from C and C++, java and World Wide Web, web browser. **Java Environment:** Java Development Kit(JDK), Application Programming Interface(API), java programming structure, java tokens, constants, variables, expressions, decision making statements and looping, java statements, overview of arrays and strings, machine neutral, Java Virtual Machine(JVM), Command Line Arguments.	
UNIT-II:	**12 hrs**
Classes, Objects and Methods: Introduction, defining a class, creating objects, accessing class members, constructors, method overloading, static members. Inheritance: Defining a sub-class, sub-class constructor, multi-level variables, final classes and finalize methods, abstract methods and classes, visibility control.**Arrays and Strings:** One-dimensional arrays, creating an array, declaration of arrays, initialization of arrays, two-dimensional arrays, string arrays, string methods, string buffer class, vectors, wrapper classes, Basic I/O Streams: Scanner, buffered reader, Collection classes.**Managing Errors and Exceptions**: Introduction, types of errors: compile time and run-time errors, exceptions, types of exceptions, syntax of exception handling code, multiple catch statements, using finally statement, throwing our own exceptions.	
UNIT-III:	**10 hrs**
Interfaces, Package and Multi-threaded Programming: Introduction, defining interfaces, extended interfaces, implementing interfaces.**Package:** Creation, importing a package and user-defined package.**Threads:** Introduction to threads, creating threads, extending the thread class, implementing the 'runnable' interface, life-cycle of a thread, priority of a thread, synchronization, and deadlock.	
UNIT-IV:	**10 hrs**
Applet programming: Introduction, how applets differ from applications, building applet code, applet life cycle, about HTML, designing a web page, passing parameters to applets, getting input from the user.**Graphics Programming:** Introduction, abstract window toolkit class hierarchy, frames, event-driven programming, layout managers, panels, canvases, drawing geometric	

figures.**Introduction to Swings:** Introduction to Swings, overview of Swing components: Jbutton, JCheckBox, JRadioButton, JLabel, JTextField, JTextArea, JList.
Text Book:
1. H. Schildt, The Java Complete References, 11th Edition, Tata McGraw Hill,2019.
Reference Books:
1. Y.Daniel Liang, An Introduction to JAVA Programming, 10th Edition, Pearson. 2. K. Sierra, Head First Java, 2nd Edition, O'Reilly Media, Inc,,2003. 3. E. Balaguruswamy, Programming with JAVA, 6th Edition, Tata McGraw Hill,2014

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to:-
CO1	Explain the basic principles of object-oriented programming along with its strength and weakness
CO2	Identify Java standard libraries and classes.
CO3	Apply the object-oriented programming techniques in developing small to medium-sized application programs and use it in real life applications.
CO4	Identify Java code utilities in applets, Java packages, and classes.
CO5	Design simple Graphical User Interface applications and use it in real world scenario.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	2		3	2	3		3	2	1	1
CO2	3	1	3	3		1	2	2	2	3
CO3	3	3	3	3	2	2	3	3	3	3
CO4	2	2	3	3	2	2	3	3	3	3
CO5	3	2	3	3	2	1	2	3	3	3

Course Code	**CSC202**
Course Name	**MOBILE COMPUTING**
Category	Programme Core Course
Prerequisite	Data Communication and Computer Networks

Paper-CSC202

Mobile Computing

UNIT-I: 10hrs

Introduction to mobile computing, mobile computing architecture, mobile devices, mobile system networks:Cellular Network and frequency reuse, Channel Assignment, Handoff Strategies, Interferences and System Capacity, Improving coverage and capacity in Cellular Systems – Cell Splitting, Sectoring, Repeaters and Range Extension, Limitations of Mobile Computing.

UNIT-II: 10hrs

Personal Communications Services (PCS): PCS Architecture, mobility management, Global System for Mobile Communication (GSM). System overview: GSM Architecture, Mobility management, Network signalling. General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes

UNIT-III: 10hrs

Mobile Network Layer: Mobile IP (Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunnelling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP).
Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.

UNIT-IV: 10hrs

Mobile Data Communication: WLANs (Wireless LANs), IEEE 802.11 standards.
Mobile Satellite Communication Networks: Case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, VPN, Mobile Ad-hoc networks, 4G Technology, Long Term Evolution (LTE).

Text Books:

1. R. Kamal, Mobile Computing, 1st Edition, Oxford University Press, 2006.
2.A K Talukder& R RYavagal ,Mobile Computing Technology, Applications & Service Creation, 2ndEdition,TMH.
3.T. S Rappaport ,Wireless Communication, 2nd Edition, Pearson,2002.

Reference Books:

1.Jochen Schiller ,Mobile Communications,Addison-Wesley,2nd Edition.
2.UWE Hansmann, LotherMerk, Martin S. Nicklaus, Thomas Stober ,Principles of Mobile Computing ,2nd Edition, Springer.
3.P.Stavronlakis ,Third Generation Mobile Telecommunication Systems,1st Edition, Springer Publishers

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Explain the basic of Mobile Computing.
CO2	Infer the fundamentals of wireless communications.
CO3	Analyze security, energy efficiency, mobility, scalability, and their unique characteristics in wireless networks.
CO4	Demonstrate basic skills for cellular networks design.
CO5	Apply knowledge of TCP/IP extensions for mobile and wireless networking.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1		1			2		
CO2	2	2		3				2	1	
CO3	2	3	3	2	2	1	1	2	2	2
CO4	2	3	3	2	2	1	1	3	3	3
CO5	2	3	1		1		1	2	2	

Course Code	**CSC203**
Course Name	**DISCRETE MATHEMATICAL STRUCTURES**
Category	Programme Core Course
Prerequisite	Basics of set theory and combinatory

Paper-CSC203

Discrete Mathematical Structures

UNIT-I: 16hrs

Fundamentals of Logic: Propositional Logic, Propositional Equivalences, Predicate and Quantifiers, nested Quantifiers, Rules of Inference. **Set Theory:** Sets, Set Operations. **Introduction to proofs**: proof by Induction, proof by contradiction, proof by cases with examples. **Mathematical Induction:** Introduction to Induction, strong Induction, Recursion.

Relations: Relations and their properties, n-ary Relations and their applications, Representing relations, Closures of relations, Equivalence relations, and Partial Orderings, lattices, partial order set, properties of lattices.

Functions: Types of Functions, Composition of Functions, Invertible Functions, Recursive Functions, Pigeon-hole principle.

UNIT-II: 06hrs

Discrete Numeric functions and Generating Functions: Discrete Numeric Functions, Generating Functions, Recurrence relations and recursive algorithms, Linear recurrence relations, Solving Recurrence Relations by Generating Functions.

UNIT-III: 10hrs

Graphs: Graphs, Graph models, special types of graphs, Representing graphs, Graph Isomorphism, connectivity, Euler and Hamilton paths, Planar graphs, Graph Coloring, Matching problem. **Trees**: Introduction to Trees, Applications of Trees, Binary Trees, n-ary Trees, Tree Traversal, Spanning Trees.

UNIT-IV: 08hrs

Algebraic Structures: Group, Semi groups ,monoids,subgroup, homomorphism, co-sets, normal subgroup, Lagrange's theorem, algebraic system of two binary operation, Boolean algebra, Boolean function and simplification, group codes, parity check, single error correcting code

Text Books:

1. C.L.Liu, D. P. Mohapatra, Elements of Discrete Mathematics: A Computer Oriented Aproach, 4th Edition, McGraw-Hill, 2016
2. K. H. Rosen, Discrete Mathematics & Its Applications (withCombinatoricsand Graph Theory), 6th Edition, McGraw-Hill, 2007.

Reference Books:

1. J.P. Tremblay, R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill, 1997.
2. R. L. Graham, D. E. Knuth, O. Patashnik, Concrete Mathematics : A Foundation for Computer Science, 2nd Edition, Pearson Education, 2007.
3. D. B. West, Introduction to Graph Theory, 2nd Edition, PHI Learning, 2009.
4. R. A. Brualdi, Introductory Combinatorics, 4th Edition, Pearson, 2004.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Able to use logical notation to define and reason about fundamental mathematical concepts such as sets, relations, and functions.
CO2	To apply mathematical foundations, algorithmic principles, and computer science theory to the modelling and design of computer based systems.
CO3	Able to construct simple mathematical proofs and possess the ability to verify them.
CO4	Model problems in Computer Science using graphs and trees methods.
CO5	To Understand and prove fundamental results and solve algebraic problems using appropriate techniques

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	2	1	2		2	3	2	1
CO2	3	2	3		3			3	3	3
CO3	2	1	1	2	3		1	3	2	1
CO4	3		3		3			1	1	2
CO5	3	2	2	1	3		2	2	3	2

Course Code:	**CSC204**
Course Name:	**THEORY OF COMPUTATION**
Category:	Programme Core Course
Prerequisite:	Fundamental of computer science and mathematics

Paper-CSC204

Theory of Computation

UNIT-I: **10hrs**

Introduction: Automata theory, Computability theory, Complexity theory,Mathematical notations & terminology, Alphabet, String, Languages & operations on strings; Finite Automata (Deterministic): Formal definition, Transition function, Extended transition function, Language of DFA, Design of DFA; Finite Automata (Non-deterministic): Formal definition, Language of NFA, Equivalence of DFA & NFA; NFA with Epsilon Transition, Conversion from Epsilon-NFA to DFA, Minimization of DFA.

UNIT-II: **10hrs**

Moore machines, Mealy machines; Regular expressions: Regular operators and their precedence, Building regular expressions, DFA to Regular expressions, Regular expressions to DFA, Arden's theorem, Pumping Lemma for Regular languages, Closure properties of Regular languages.

UNIT-III: **10hrs**

Introduction to Grammars: Definition, Derivation of string, Left and right linear grammars, Regular grammars; Context Free Grammars (CFG): Definition, Derivation of string, Language of CFG, Parse Tree, Ambiguity in grammar,Elimination of ambiguity, Normal forms of CFG: Chomsky and Greibachnormal forms, Converting CFG to CNF & GNF, Closure properties of context free languages (CFL).

UNIT-IV: **10hrs**

Push Down Automata(PDA): PDA Components, Moves of a PDA, Design of a PDA, PDA to CFG and CFG to PDA conversion, Pumping lemma for CFL;

Turing Machines (TM): Design of a TM, Variation of TM, Recursively Enumerable Languages and undecidable problems. Church Turing hypothesis, Recursive and recursively enumerable sets, Chomsky's hierarchy of languages. Godel numbering; NP Completeness: P and NP, NP complete and NP Hard problems.

Text Books:

1. J. 1.E. Hopcroft, R. Motwani, and J. D. Ullman, Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson Education, 2007.
2. P. Linz, An Introduction to Formal Languages and Automata, 4th Edition, Jones & Bartlett Learning, 2006.

Reference Books:

1. M. 1.Sipser, Introduction to the Theory of Computation, 3rd Edition, Cengage Learning, 2012.
2. J. 2.C. Martin, Introduction to Languages and the Theory of Computation, 4th Edition, Tata McGraw-Hill, 2010.
3. K. 3.L. P. Mishra, and N. Chandrasekaran, Theory of Computer Science: Automata, Languages and Computation, 3rd Edition, PHI, 2012.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Develop and implement mathematical models with DFA, NFA for regular languages.
CO2	Design regular expression for regular sets.
CO3	Design and implement grammar and PDA for context free languages and demonstrate their properties. Construct Turing machines for context sensitive and un-restricted languages.
CO4	Describe the Chomsky hierarchy of Formal Languages and Grammar.
CO5	Explain the concept of decidability & recursive enumerability, and classify a given language to the P, NP or NPC complexity classes.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3		3		3			3	3	3
CO2	3		3		3			3	3	3
CO3	3		3		3			3	3	3
CO4	3		3		3			3	3	3
CO5	3		3		3			3	3	3

Paper-CSC205

Lab II: OOP using Java and Theory of Computation

JAVA PROGRAMS:

1. Programs to illustrate class and objects
2. Programs to illustrate Overloading & Overriding methods in Java.
3. Programs to illustrate constructors
4. Programs Illustrate the Implementation of Various forms of Inheritance. (Ex. Single,Hierarchical, Multilevel inheritance….)
5. Program which illustrates the implementation of multiple Inheritance using interfaces in Java.
6. Program to illustrate the implementation of abstract class.
7. Programs to illustrate Exception handling
8. Programs to create Packages in Java.
9. Program to Create Multiple Threads in Java.
10. Program to Implement Producer/Consumer problem using synchronization
11. Developing a simple paint like program using applet
12. Developing programs on JButtons,JTextBox,JTextButton etc.

TOC PROGRAMS:

1. Review of C-Programming and use of JFLAP.
2. Simulation of DFA for a specific language using C program.
3. Simulation of DFA using JFLAP.
4. Simulation of a generalized DFA to recognize any given language.
5. Simulation of NFA using JFLAP.
6. NFA to DFA conversion using JFLAP.
7. DFA minimization using JFLAP.
8. String parsing for a CFG using JFLAP.
9. Design of PDA using JFLAP.
10. Design of TM using JFLAP

Course Code:	**CSC206 A**
Course Name:	**DATA WAREHOUSING AND MINING**
Category:	Programme Elective Course
Prerequisite:	Data Structure and Algorithm, Linear Algebra, Basics of Web programming

DSE Paper – CSC206A

Data Warehousing and Mining

UNIT-I: **10hrs**

Evolution of Decision Support Systems- Data warehousing Components –Building a Data warehouse, Data Warehouse and DBMS, Data marts, Metadata, Multidimensional data model, OLAP vs OLTP, OLAP operations, Data cubes, Schemas for Multidimensional Database: Stars, Snowflkes and Fact constellations.

UNIT-II: **10hrs**

Types of OLAP servers, 3–Tier data warehouse architecture, distributed and virtual data warehouses. Data warehouse implementation, tuning and testing of data warehouse. Data Staging (ETL) Design and Development, data warehouse visualization, Data Warehouse Deployment, Maintenance, Growth, Business Intelligence Overview- Data Warehousing and Business Intelligence Trends - Business Applications.

UNIT-III: **10hrs**

Data mining-KDD versus datamining, Stages of the Data Mining Process-task premitives, Data Mining Techniques -Data mining knowledge representation – Data mining query languages, Integration of a Data Mining System with a Data Warehouse – Issues, Data preprocessing – Data cleaning, Data transformation, Feature selection, Dimensionality reduction, Discretization and generating concept hierarchies-Mining frequent patterns- association-correlation.
Decision Tree Induction - Bayesian Classifiation – Rule Based Classifiation –Classifiation by Back propagation – Support Vector Machines – Associative Classifiation – Lazy Learners – Other Classifiation Methods.

UNIT-IV: **10hrs**

Clustering techniques – , Partitioning methods- k-means Hierarchical Methods - distance-based agglomerative and divisible clustering,
Mining complex data objects, Spatial databases, temporal databases, Multimedia databases, Time series and Sequence data; Text Mining –Graph mining-web mining-Application and trends in data mining

Text Books:

1.Jiawei Han and MichelineKamber, Data Mining: Concepts and Techniques, 3rd Edition, MorganKaufmann Publishers, ,2011.
2.Alex Berson and Stephen J. Smith, " Data Warehousing, Data Mining & OLAP",10thEdition,TataMcGraw Hill Edition, ,2007.
3.G. K. Gupta, "Introduction to Data Min Data Mining with Case Studies", Easter EconomyEdition, Prentice Hall of India, 2006

Reference Books:

1.Mehmedkantardzic,Datamining:Concepts,Models,Methods and Algorithms,Wiley,Interscience, 2003.

2.Ian Witten, Eibe Frank, Data Mining; Practical Machine Learning Tools and Techniques, 3rd Edition, Morgan Kaufmann, 2011.
3.George M Marakas, Modern Data Warehousing, Mining and Visualization, Prentice Hall,2003.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Describe the requirement of a data warehouse and its components.
CO2	Explain the data warehouse life cycle.
CO3	Explain the concepts of data mining and data pre-processing.
CO4	Analyze different classification algorithms and apply the same to real life problems.
CO5	Apply different clustering algorithms for solving problems in various domains.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	2						1	2	2	2
CO2	2						1	2	2	2
CO3	3		2	2			2	3	3	3
CO4	3		3	3	3		3	3	3	3
CO5	3		3	3	3		3	3	3	3

Course Code	**CSC206B**
Course Name	**WIRELESS SENSOR NETWORKS**
Category	Programme Elective Course
Prerequisite	Basic Idea of Computer Networks

DSE Paper – CSC206B

Wireless Sensor Networks

UNIT-I: **10hrs**

Introduction:Networked wireless sensor devices, Applications: Habitat Monitoring, Smart Transportation, Key design challenges. **Network deployment:** Structured versus randomized deployment, Network topology, Connectivity. Introduction to cloud system, Sensor Cloud Systems, Challenges in Sensor Cloud Systems.

UNIT-II: **8hrs**

Localization: issues & approaches, Coarse-grained & Fine-grained node localization, Network-wide localization. **Wireless characteristics:** Basics, Wireless link quality, Radio energy considerations, SINR capture model for interference.

UNIT-III: **10hrs**

Issues in designing MAC protocol for WSNs, Classification of MAC Protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques.
Classification of Energy Management Schemes **Sleep-based topology control:** Constructing topologies for connectivity, constructing topologies for coverage.

UNIT-IV: **12hrs**

Routing: Metric-based approaches, Routing with diversity, Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Geographic routing. Data-centric routing, Data-gathering with compression, Querying, Data-centric storage and retrieval, The database perspective on sensor networks.

Text Books:

1. Kazem Sohraby, Daniel Minoli, TaiebZnati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley Inter Science.
2. Bhaskar Krismachari, Networking Wireless Sensors,1st Edition,Cambridge University Press

Reference Books:

1. Edgar H. Callaway, Wireless Sensor Networks: Architectures and Protocols, 1st Edition,Jr. Auerbach Publications, CRC Press.
2. C.S Raghavendra, Krishna M, Sivalingam, TaiebZnati, Wireless Sensor Networks, 1st Edition,Springer.
3. Victor Lesser, Charles L. Ortiz, and Milind Tambe, Distributed Sensor Networks: A Multiagent Perspective, 1st Edition,Kluwer Publications.
4.Feng Zhao, Leonidas Guibas , Morgan Kaufmann, Wireless Sensor Networks: An Information Processing Approach, 1st Edition,Series in Networking 2004.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Define the basic concepts of wireless sensor networks, sensing, and challenges.
CO2	Explain various deployment structures of wireless sensor networks.
CO3	Describe and explore localization, radio standards and wireless characteristics.
CO4	Discuss the communication protocols adopted in wireless sensor networks and distinguish energy management schemes.
CO5	Analyze different routing techniques and identify various storage and retrieval issues.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3							1		
CO2	3		1	1	1		1	1	1	1
CO3	3			1	1		1		1	
CO4	3		2	2	2		2	2	2	
CO5	3		3	3	3		3	2	2	3

Course Code	**CSC206C**
Course Name	**INTERNET OF THINGS**
Category	Programme Elective Course
Prerequisite	Basic Idea of Computer Networks

DSE Paper –CSC 206C

Internet of Things

UNIT-I: 10hrs

Introduction to IoT, Basic requirements for building an IoT system, IoT reference framework, IoT network level – performance criteria.

IoT devices: Sensors, Types of sensors and their functions: temperature, pressure, air pollution, proximity, infrared, moisture & humidity, flow, level, noise, and speed sensors. Characteristics of sensors. Use of RFID

Actuators, Types of actuators and their functions: electrical, mechanical, and hydraulic actuators, controlling IoT devices

UNIT-II: 10hrs

IoT requirements for networking protocols, device addressing, credential management, wireless spectrum, determinism, security and privacy, application interoperability, semantic interoperability. IoT Protocol Stack: layered view.

Link layer: IEEE 802.15.4 technology, LoRaWAN end-to-end architecture, Time-Sensitive Networking

Internet Layer: Routing Protocol for Low-Power and Lossy Networks.

UNIT-III: 10hrs

Application Protocols Layer: Data Serialization Formats, Communication Paradigms: Request/Response Versus Publish/Subscribe, Blocking Versus Non-blocking, QoS: Resource Utilization, Data Timeliness, Data Availability, Data Delivery

IoT Application Protocols: CoAP, XMPP, MQTT, AMQP, SIP, IEEE 1888, and DDS RTPS.

Application Services Layer: ETSI M2M network architecture, oneM2M standards.

IoT Services Platform: Functions and Requirements, IoT Platform Manager, Discovery, Communication Manager, Data Management, Management of IoT Devices, Configuration and Fault Management, Performance Management and measures

UNIT-IV: 10hrs

IoT security and Privacy: challenges, requirements, IoT Three-Domain Architecture, Attacks and Countermeasures for each domain.

Applications of IoT in areas like Smart home, Agriculture, Healthcare, Industry, Transportation, Retail, Oil and Gas, Energy etc. IoT Service Model: Anything as a Service, IoT Connected Ecosystems Models

Text Book:

1. AmmarRayes and Samer Salam, Internet of Things from Hype To Reality: The Road to Digitization,2nd Edition, Springer, 2019.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Describe basic concepts of IoT, its architecture and system design.
CO2	Employ the communication mechanisms between sensors and systems using various protocols and network models.
CO3	Explain IoT with respect to machine to machine and design IoT systems with data synchronization and resource manipulation. Explore various application protocols.
CO4	Discuss and describe different security issues and challenges.
CO5	Identify real world applications of IoT in multidisciplinary domains.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3		2		1			1	3	3
CO2	3		3		3			1	3	3
CO3	3		3		3			1	3	3
CO4	3		3		3			1	3	3
CO5	3		3		3			1	3	3

Course Code	**CSC206D**
Course Name	**Microprocessor and Microcontroller**
Category	Programme Elective Course
Prerequisite	Basic ofComputerOrganization and Architecture

DSE Paper –CSC 206D

Microprocessor and Microcontroller

UNIT-I: 10hrs

8085 AND 8086 Microprocessors: Architecture, Pin diagram, Physical memory organization, Timing diagrams, Interrupts of 8085, Instruction set and Assembly Language Programming of 8085.
8086 Microprocessor: Architecture, signal descriptions, common function signals, Minimum and Maximum mode signals, addressing modes, interrupt structure.

UNIT-II: 10hrs

I/O Interfacing: Interfacing with 8086/ 8085: Interfacing with RAMs, ROMs along with the explanation of timing diagrams. Interfacing with peripheral ICs like 8255, 8254, 8279, 8259, 8259 etc. Interfacing with key boards, LEDs, LCDs, ADCs, and DACs etc.
Introduction to microprocessors like 80386, 80486

UNIT-III: 10hrs

8051 Microcontrollers: Overview of 8051 microcontroller Architecture. I/O Ports. Memory organization, addressing modes and instruction set of 8051, Interrupts, timer/Counter and serial communication, programming Timer Interrupts, programming external hardware interrupts, programming of serial communication interrupts, programming 8051 timers and counters, Introduction to other micro controllers.

UNIT-IV: 10hrs

Real World Interfacing Design With 8051: Real world interface design: LED, SWITCH, keyboard, LCD, ADC, DAC, UART, RTC, PWM, Watch Dog Timer, DC Motor, Stepper Motors.

Text Books:

1. A.K. Roy and K.M. Bhurchandi ,Advance Microprocessor and Peripherals, Tata McGraw-Hill Education.
2. Mazidi and Mazidi, The 8051 Microcontroller and Embedded Systems using Assembly and C,2nd Edition,Pearson Education.
3. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, 5th Edition, Penram International Publishing

Reference Books:

1. Walter A. Triebel&Avtar Singh ,The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, andApplications , 4th Edition.
2. D. V. Hall,Micro processors and Interfacing,2nd Edition, TMGH.
3. Kenneth. J. Ayala, The 8051 Microcontroller Architecture, Programming and Applications, Cengage learning.
4. Ajay. V. Deshmukh ,Microcontrollers:Theory and Applications, Tata McGraw-Hill Education

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Analyze role of microprocessor and microcontroller in computer systems.
CO2	Distinguish between maskable and non-maskable interrupt, and role of DMA in microprocessor.
CO3	Analyze working of 8086 and its architecture.
CO4	Analyze the data transfer information through serial & parallel ports.
CO5	Identify a detailed s/w & h/w structure of the Microprocessor.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	1	1			1	2	1
CO2	1	1			1					
CO3	2	1	1	2	2	2	1	2	2	1
CO4	2	1			1					
CO5	1	1	1	1	1	1		1	2	2

Semester-III

Course Code:	**CSC301**
Course Name:	**COMPILER CONSTRUCTION**
Category:	Programme Core Course
Prerequisite:	Theory of Computation / Automata theory

Paper-CSC301	
Compiler Construction	
UNIT-I:	**12 hrs**
Introduction: Overview and Phases of compilation. Lexical Analysis: Non-Deterministic and Deterministic Finite Automata (NFA & DFA), Regular grammar, Regular expressions and Regular languages, Design of a Lexical Analyzer as a DFA, Lexical Analyzer generator, Lex.	
UNIT-II:	**14 hrs**
Syntax Analysis: Context free grammars and Context free languages, Parse trees and derivations, Ambiguous grammar. Parser, Top down Parsing: Recursive descent parsing, LL (1) grammars, Non-recursive Predictive Parsing, Error reporting and Recovery. Bottom Up Parsing: Handle pruning and shift reduces Parsing, SLR parsers and construction or SLR parsing tables, LR(1) parsers and construction of LR(1) parsing tables, LALR parsers and construction of efficient LALR parsing tables, Parsing using Ambiguous grammars, Error detection, Parser generator.	
UNIT-III:	**08 hrs**
Syntax Directed Translation – Syntax Directed Definitions. Evaluation Orders for SDDs. Applications of Syntax Directed Translation. Symbol Table Organization - Structure of Symbol table, Symbol Table organization, Data Structures of symbol Table. Intermediate code generation: Intermediate code (IC), IC for various constructs in programming language.	
UNIT-IV:	**06 hrs**
Machine code generation, Issues in the design of a code Generator, Machine code generation scheme. Elements of code optimization, Peephole Optimization, Elimination of redundant loads and stores, Elimination of unreachable code, Elimination of jump over jumps, Elimination of local common sub-expressions, Basics of flow of control optimization.	
Text Book:	
1.A. V. Aho, M. S. Lam, R. Sethi and J. D. Ullman, Compilers: Principles, Techniques &Tools , 2nd Edition, Pearson Education, 2007.	
Reference Book:	
1.K. D. Cooper and L. Tarezon T. Munakata, Engineering a Compiler, 2nd Edition, Elsevier, 2011.	

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Identify phases of a compiler, process of designing lexical analyzer, and apply LEX tool.
CO2	Construct parsing tables and implement parser using BISON tool.
CO3	Understand use of symbol table and design SDT as semantic analyzer for a language.
CO4	Generate intermediate code using lexical analyzer, parser and semantic analyzer.
CO5	Translate intermediate code to machine code, handle run-time environment, and apply code optimization techniques.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3		3		3			3	3	3
CO2	3		3		3			3	3	3
CO3	3		3		3			3	3	3
CO4	3		3		3			3	3	3
CO5	3		3		3			3	3	3

Course Code	**CSC302**
Course Name	**DATA BASE MANAGEMENT SYSTEMS**
Category	Programme Core Course
Prerequisite	Basic Understanding of Algorithms and Data Structures

Paper-CSC302

Database Management Systems

UNIT-I: 10hrs

Introduction to DBMS: Characteristics, Purpose, Application of the Database approach, Advantages of using DBMS approach upon file structure, Three-schema Architecture, Data Abstraction, Data Independence, Data base languages, DBMS Architecture, Data Models overview, Introduction to ER model and Relational data model.
Relational Query Language: Relational algebra, Tuple and Domain Relational Calculus, SQL.

UNIT-II: 12hrs

Database Design and ER model: Overview of Design Process, Entities, Attributes, Constraints, Weak Entities, ER diagram, Extended ER Features, Reduction to Relational Schemas.
Relational Database Design: Feature of Good Relational Design, Atomic Domain and First Normal Form, Functional Dependency Theory, Decomposition of Schemas, Properties of Relational Decompositions, Normal forms and Normalization, 2NF, 3NF, BCNF, Multivalued Dependencies & 4NF. Performance tuning and Denormalization

UNIT-III: 8hrs

Query Processing and Optimization: Evaluation of Relational Algebra Expression, QueryEquivalence, Join strategy, Query optimization algorithms. **Storage Strategies:** Indices, B+Trees, Hashing

UNIT-IV: 10hrs

Transaction Processing: Transaction Concept, ACID Properties of Transaction, Serializability, Recoverability.
Concurrency Control: Overview, Lock-based Protocol, Timestamp ordering protocol, Multi version and Optimistic concurrency control techniques.
Recovery Systems: Database Failure and Recovery, Log based Recovery to preserve Atomicity and Durability

Text Book:

1.A. Silberschatz, F. H. Korth, Database System Concepts, 6th Edition, MGH, 2010.

Reference Books:

1. R. Elmasri, Fundamental of Database Systems,7th Edition, Pearson Education, 2008.
2. B. Desai, An Introduction to Database System, 2nd Edition,Galgotia publication.
3.C.J. Date, An Introduction to Database Systems, 8th Edition,Pearson Education

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to
CO1	Define the basics of databases, database management systems, architecture of database systems, and the role of database users. Explain effectively the features of database management systems and data models.
CO2	Construct formal queries using relational algebra and relational calculus and structured query languages to perform database operations.
CO3	Identify the attributes to code a real world entity and create E-R models for designing databases for real-world applications. Examine the database design to check for improvement using normalization.
CO4	Describe various indexing techniques and explain the basics of query evaluation mechanisms.
CO5	Recognize the state of a database instance. Apply concurrency control and recovery mechanisms to maintain the correctness and consistency in the database.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3				1		1			
CO2	3				1		2	2	2	
CO3	3		3		1		2	3	3	
CO4	3		2	1	1		2			2
CO5	3		2		1		2	2		

Course Code	**CSC303**
Course Name	**DESIGN AND ANALYSIS OF ALGORITHMS**
Category	Programme Core Course
Prerequisite	Data Structure

Paper-CSC303

Design and Analysis of Algorithms

UNIT-I: **10hrs**

Introduction to Design and analysis of algorithms, Growth of Functions (Asymptotic notations), Recurrences, Solution of Recurrences by substitution, Recursion tree method, Master Method, Analysis of Searching and Sorting Techniques: Brute Force Technique, Selection sort, Bubble sort.

UNIT-II: **10hrs**

Divide and Conquer: Merge sort, Quick sort, Time complexity analysis for Merge and Quick sort.

Transform and Conquer: Balanced search tree, Heaps and Heap sort. Dynamic Programming algorithms: Matrix Chain Multiplication, Elements of Dynamic Programming, Longest Common Subsequence, 0/1 Knapsack problem.

UNIT-III: **10hrs**

Greedy Algorithms: Activity Selection Problem, Elements of Greedy Strategy, Fractional Knapsack Problem, Huffman Codes. Graph Algorithm - BFS and DFS, Minimum Spanning Trees, Kruskal algorithm, Prim's Algorithm, Single Source Shortest paths, Bellmen Ford Algorithm, Dijkstra's Algorithm.

UNIT-IV: **10hrs**

String matching, Rabin-Karp Algorithm, KMP Algorithms. Theory of NP-completeness: Complexity classes of P, NP, NP-Hard, NP complete. Polynomial reduction, Cook's theorem, discussion on SAT, CNF-SAT, Min vertex cover, max clique, Graph coloring.

Text Book:

1. T.H.Coreman et.al. Introduction to Algorithms,3rd Edition,MIT press Cambridge, 2010.

Reference Books:

1.M. R. Kabat, Design and Analysis of Algorithms, 1st Edition,PHI, 2013.
2. S. Sridhar, Design and Analysis of Algorithms, Oxford University Press,2015.
3. E. Horowitz, S. Sahni, Fundamentals of Computer Algorithms, 2ndEdition,ComputerScience press, 2010.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to
CO1	Describe asymptotic notation, its properties and use it in measuring algorithm behaviour
CO2	Apply mathematical principles in analysis of algorithms to solve real world problems
CO3	Analyze and apply the complexities of various algorithms and select the best one
CO4	Know the different strategies that are known to be useful in finding efficient algorithms to solve problems and to be able to apply them in real scenario
CO5	Choose appropriate data structures and algorithms and use it to design algorithms for a specific problem

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2		2	3	2	1	3	3	3
CO2	2	2	3	2	3	2	1	2	2	2
CO3	2	2	3	3	2	1	2	3	3	3
CO4	2	3	3	3	2	3	2	2	2	3
CO5	2	3	2	3	2	3	2	3	3	3

Course Code	**CSC304A**
Course Name	**Data Science**
Category	Programme Elective Course
Prerequisite	Statistics, Mathematics, Programming Knowledge

Paper-CSC304A

Data Science

UNIT-I: **8hrs**

Brief Introduction to Data Science. Descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, hypothesis testing

UNIT-II: **8hrs**

Introduction to Machine Learning: Supervised Learning, Decision Tree Induction, Naïve Bayes Classification, Rule based Classification, K-Nearest Neighbour, Unsupervised Machine learning, Clustering, K-Means, Association rule mining, Apriori, FP-Tree

UNIT-III: **12hrs**

Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures, Data pre-processing: Data cleaning, Data transformation, Data reduction.
Predictive Modelling: Regression, Decision Tree, SVM.

UNIT-IV: **12hrs**

Feature selection (Filters; Wrappers), Dimensionality reduction: PCA and LDA.
Ensemble Learning, Bagging, Boosting, Gradient Boosting (Random Forest, Adaptive Boosting)
Time Series Data Analysis: Introduction to Time Series, Correlation, Forecasting (Univariate): Autoregressive Moving Average (ARMA) models, Autoregressive Integrated Moving Average (ARIMA) models, Introduction to Deep Learning.

Text Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly. 2014.
2. James, G., Witten, D., Hastie, T., Tibshirani, R. An introduction to statistical learning with applications in R. Springer, 2013.Joel Grus, Data Science from Scratch: First Principles with Python. 1st Edition.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson.
4. Laura Igual and Santi Seguí, Introduction to Data Science, Springer.

Reference Books:

1.Han, J., Kamber, M., Pei, J. Data mining concepts and techniques. Morgan Kaufmann, 2011.
2. “Practical Data Science with R”. Nina Zumel, John Mount. Manning, 2014.
3. Davy Cielin, Arno Meysman, Mohamed Ali, Introducing Data Science, Manning
4. Andreas, Practical Data Science, Apress

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modelling, and statistics.
CO2	Practice problem analysis and decision-making.
CO3	Gain practical, hands-on experience with statistical programming languages and tools through coursework and applied research experiences.
CO4	Analyze and interpret data using an ethically responsible approach.
CO5	Apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3		2		2			1	1	1
CO2	3		3		3			3	3	3
CO3	3		3		3			3	3	3
CO4	3		3		3			3	3	3
CO5	3		3		3			3	3	3

Course Code	**CSC304B**
Course Name	**WEB TECHNOLOGY**
Category	Programme Elective Course
Prerequisite	Knowledge of Internet basics, Database and object oriented programming

Paper-CSC304B

Web Technology

UNIT-I: 8hrs

Web Essentials: Clients, Servers, and Communication. The Internet-Basic Internet Protocols - The World Wide Web-HTTP request message-response message-Web Clients Web Servers-Case Study. **Markup Languages: XHTML**. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-XML Creating HTML Documents-Case Study.

UNIT-II: 8hrs

Style Sheets: CSS-Introduction to Cascading Style Sheets-Features-Core Syntax-Style Sheets and HTML Style Rule Cascading and Inheritance-Text Properties-Box Model-Normal Flow Box Layout-Beyond the Normal Flow-Other Properties-Case Study. **Client-Side Programming:** The JavaScript Language-History and Versions Introduction to JavaScript in Perspective-Syntax-Variables and Data Types-Statements-Operators-Literals-Functions-Objects-Arrays-Built-in Objects-JavaScript Debuggers.

UNIT-III: 12hrs

PHP: Introducing PHP, PHP Language Basics–Using variables, Understanding Data Types, Operators and Expressions, Constants. Decisions and Loops–Making Decisions, Doing Repetitive Tasks with Looping, Mixing Decisions and Looping with HTML. **Strings**–Creating and Accessing Strings, Searching Strings, Replacing Text with strings, Dealing with Upper and Lowercase, Formatting Strings. **Arrays**–Creating Arrays, Accessing Array Elements, Looping Through Arrays with for-each, Working with Multidimensional Arrays, network andManipulating Arrays. **Functions**, writing your own Functions, Working with References, Writing Recursive Functions. Objects–Introduction OOP Concepts, Creating Classes and Objects in PHP, Creating and using Properties, Working with Methods.

UNIT-IV: 12hrs

PHP MySQL: Handling HTML Forms with PHP–How HTML form works, Capturing Form Data with PHP, Dealing with Multi-Value Fields, Generating Web Forms with PHP, Storing PHP Variables in Forms, Creating File Upload Forms, Redirecting After a Form Submission. **Introducing Databases and SQL**–Deciding How to Store Data, Understanding Relational Databases, Setting Up MySQL, A Quick Play with MySQL, Connecting MySQL from PHP. **Retrieving Data from MySQL with PHP**–Setting Up the Book Club Database, Retrieving Data with SELECT, Creating a Member Record Viewer. Manipulating MySQL Data with PHP–Inserting, Updating, and Deleting Records.

Text Books:

1. M. Doyle, Beginning PHP 5.3, 1st Edition, John Wiley & Sons, 2011.
2. J. Duckett, Beginning HTML, XTML, CSS and JavaScript, 1stEdition,John Wiley & Sons, 2011

Reference Book:

1. L. Welling, L. Thomson, PHP and MySQL Web Development, 1st Edition, Sams Publishing, 2003.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to
CO1	Identify basic HTML elements, XML elements and develop static webpages.
CO2	Describe different styles in web page design. Apply style sheets and java script to prepare elegant webpages with client side validations.
CO3	Implement server side business logic into dynamic web pages using PHP.
CO4	Use PHP to design user interactive forms for data entry with proper validation.
CO5	Develop aesthetic web applications with database connectivity using PHP.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3		1	1	1		1	1	1	1
CO2	3		2	2	2		2	2	2	2
CO3	3		3	3	3		3	3	3	3
CO4	3		3	3	3		3	3	3	3
CO5	3		3	3	3		3	3	3	3

Course Code	**CSC304C**
Course Name	**INFORMATION SECURITY**
Category	Programme Elective Course
Prerequisite	Computer Network

Paper-CSC304C

Information Security

UNIT-I: 8hrs

Attacks on Computers and Computer Security: Introduction, The need for security, Security goals, Security attacks(Attack on Confidentiality,Integrity,Availability)Security Services and Mechanisms, Techniques(Cryptography,Steganography).

Introduction to plain text and cipher text, encryption and decryption. substitution techniques, transposition techniques, symmetric and asymmetric key cryptography, steganography, possible types of cryptanalysis attacks.

UNIT-II: 12hrs

Symmetric key Ciphers: Block Cipher principles &Algorithms(DES, AES, Blowfish), Differential and Linear Cryptanalysis, Block cipher modes of operation, Stream ciphers RC4,Location and placement of encryption function.

Introduction to number theory-Prime numbers,Euler's Phi-Function,Fermat's and Euler's theorem, Chinese Remainder Theorem,Generating Primes(MersennePrime,Fermat Prime),Primality testing(Deterministic algorithms,Probalistic algorithms)

Asymmetric key Ciphers: Principles of public key cryptosystems, Algorithms(RSA, Diffie-Hellman), Key Distribution.

UNIT-III: 10hrs

Message Authentication Algorithms and Hash Functions: Message authentication (MDC,MAC)Nested MAC,HMAC,CMAC,Whirlpool. Hash functions: MD5 Message Digest algorithm,SHA-1. Digital signatures, Authentication Applications: Kerberos, X.509 Authentication Service, Public — Key Infrastructure, Biometric Authentication.

UNIT-IV: 10hrs

E-Mail Security: Pretty Good Privacy, S/MIME IP **Security:lP** Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, key management.

Web Security: Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction. Intrusion Detection System(types, techniques).

Intruders, Virus and Firewalls: Intruders, Intrusion detection, password management, Virus and related threats, Countermeasures, Firewall design principles, Types of firewalls.

Text Book:

1. B. A. Forouzan,D.Mukhopadhyay,Cryptography and Network Security, 2nd Edition, McGraw Hill, 2008.

Reference Books:
1. A. Kahate, Network Security, 2nd Edition, McGraw Hill, 2008. 2. W. Stalling, Cryptography and Network Security, 7th Edition, Pearson Education

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Analyze the working of various Symmetric and Asymmetric key cryptographic algorithms for information security purpose
CO2	Identify the basic categories of threats in a networks
CO3	Able to demonstrate the design and use of hash functions, digital signatures, and key distribution with a wide range of key types
CO4	Discuss about Web security and Firewalls
CO5	Discuss about Intrusion Detection system.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PS1**	**PS2**	**PS3**
CO1	2	2	2	1	3	1	1	2	2	1
CO2	2	1	2	1	2	1	1	2	1	2
CO3	2	2	2	2	2	2	2	2	2	2
CO4	2	2	2	1	2	1	2	2	2	1
CO5	2	2	2	2	2	2	2	2	2	2

Course Code	**CSC 304D**
Course Name	**DIGITAL IMAGE PROCESSING**
Category	Program Elective Course
Prerequisite	Basics of Digital Electronics and Basic understanding of calculus

Paper-CSC304D

Digital Image Processing

UNIT-I: **08hrs**

Digital Image Fundamentals and Transforms: Elements of visual perception: Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Image sampling and quantization Basic relationship between pixels: Basic geometric transformations-Introduction to Fourier Transform and DFT : Properties of 2D Fourier Transform , FFT, Separable Image Transforms ,Walsh – Hadamard – Discrete Cosine Transform, Haar, Slant – Karhunen – Loevetransforms.Perspective Projection, Spatial Domain Filtering, sampling and quantization

UNIT-II: **08hrs**

Image Enhancement Techniques: Spatial Domain methods: Basic grey level transformation, Histogram equalization, Image subtraction, Image averaging, Spatial filtering: Smoothing, sharpening filters,Laplacian filters, Frequency domain filters : Smoothing, Sharpening filters,Homomorphic filtering.

UNIT-III: **16hrs**

Image Restoration and Image Compression: Model of Image Degradation/restoration process: Noise models, inverse filtering, least mean square filtering, constrained least mean square filtering, blind image restoration, Pseudo inverse, Singular value decomposition.

Lossless compression: Variable length coding: LZW coding, Bit plane coding- predictive coding, DPCM.

Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG, MPEG, Basics of Vector quantization

UNIT-IV: **08hrs**

Image Segmentation and Representation: Edge detection: Thresholding, Region Based segmentation, Boundary representation: chair codes, Polygonal approximation, Boundary segments: boundary descriptors: Simple descriptors, Fourier descriptors, Regional descriptors, Simple descriptors, Texture.

Text Book:

1.Rafael C Gonzalez and Richard E Woods ,Digital Image Processing, 4th Edition, Prentice Hall,2002.

Reference Books:

1. Anil K Jain ,Fundamentals of Digital Image Processing, Prentice Hall
2. William K Pratt, John Willey ,Digital Image Processing, 4th Edition, CRC Press,2001.
3. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing Analysis and Machine Vision, 4th Edition.
4. B. Chanda, D. DuttaMagundar ,Digital Image Processing and Analysis,2nd Edition, Prentice Hall of India, 2000.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Understand the need for image transforms and their properties
CO2	Develop any image processing application.
CO3	Understand the rapid advances in Machine vision
CO4	Learn different techniques employed for the enhancement of images
CO5	Understand a digital image and different processing techniques for the better analysis of an image

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

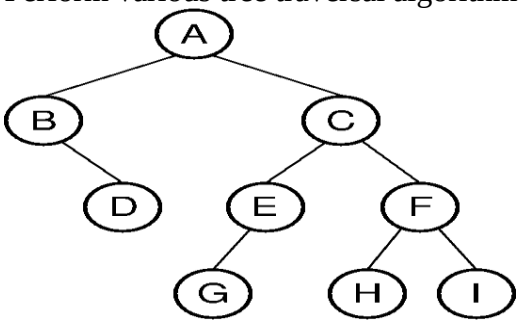
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	2			1	1		2	3	3	3
CO2	3	3	2	2	2	1	3	2		
CO3	2	3	1	3	2	1	2		2	3
CO4	2			3	3	1	3		2	3
CO5	2	1	3	3	3	3	3	2	3	3

Paper-CSC305

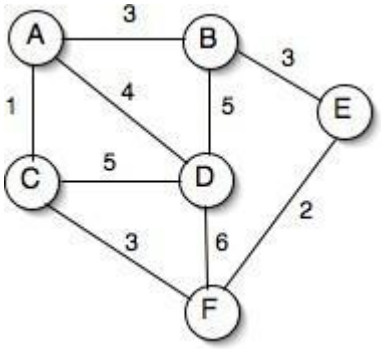
Lab III: Algorithms and DBMS

ALGORITHM PROGRAMS:

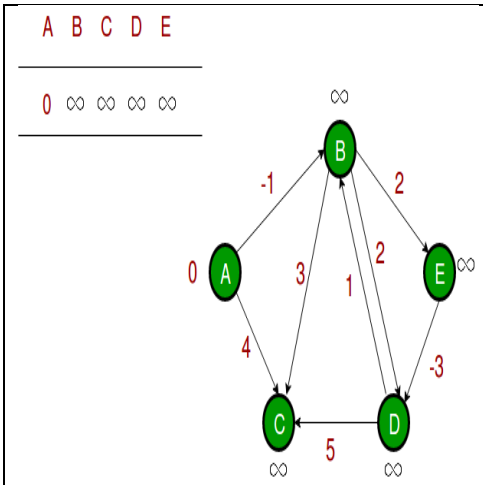
1. Sort a given set of elements using Selection Sort and Merge Sort and determine the time taken to sort the elements.The elements can be read fromafileorcanbe generatedusingtherandomnumbergenerator.
2. Sort a given set of elements using Merge Sort and Quick Sort and determine the time taken to sort the elements.The elements can be read fromafileorcanbegeneratedusingtherandomnumbergenerator.
3. Implement 0/1 Knapsack problem using dynamic programming.
4. Perform various tree traversal algorithm for the given tree**.**



5. Print all the nodes reachable from a given starting node in a digraph using BFS method.
6. Check whether a given graph is connected or not using DFS method.
7. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
8. Find theMinimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.



9.Implement Bellmen Ford algorithm as per the given input and output



Input: Graph and a source vertex
Output: Shortest distance to all vertices from the source. If there is a negative weight cycle, then shortest distances are not calculated, negative weight cycle is reported.
10. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm

DBMS PROGRAMS:

1. Creation of a tables using create command and writing SQL queries to retrieve information from the tables.
2. Implement data definition languages (Create, Alter, Drop, Truncate, and Rename) &data manipulation languages (Insert, Update, and Delete) for updating and viewing records.
3. Implement SELECT command with different clauses (where clause, having clause, group by clause, order by clause).
4. Implement Single Row function (character, numeric, data functions).
5. To implement Group function (AVG, MIN, MAX, SUM).
6. Implement various types of integrity constraints (NOT NULL Constraint, DEFAULT Constraint, UNIQUE Constraint, PRIMARY Key, FOREIGN Key, CHECK Constraint).
7. Creation of Views, Synonyms, Sequence, Indexes, Save point.
8. Creating relationship between tables.
9. Implementation of PL/SQL block.
10. Write a PL/SQL block to satisfy some conditions by accepting input from theuser.
11. Write a PL/SQL block that handles all types of exceptions.

IDSE PAPERS:

Course Code	**CSC306A**
Course Name	**NETWORK AND INTERNET TECHNOLOGIES**
Category	IDSE course
Prerequisite	Basic Mathematics

IDSE-Paper-CSC306A

Network and Internet Technologies

UNIT-I: 10hrs

Computer Networks: Introduction to computer network, datacommunication, components of data communication, data transmission mode, data communication measurement, LAN, MAN, WAN, wireless LAN, internet, intranet,extranet.
Network Models: Client/ server network and Peer-to-peer network, OSI, TCP/IP, layersandfunctionalities.

UNIT-II: 10hrs

Transmission Media: Introduction, Guided Media: Twisted pair, Coaxial cable, Opticalfiber. Unguided media: Microwave, Radio frequency propagation,Satellite.**LAN Topologies:** Ring, bus, star, mesh and treetopologies.**Network Devices:** NIC, repeaters, hub, bridge, switch, gateway androuter.**Internet Terms:** Web page, Home page, website, internet browsers, URL, Hypertext, ISP, Web server, download and upload, online andoffline.

UNIT-III: 10hrs

Introduction to Web Design: Introduction to hypertext markup language (html) Document type definition, creating web pages, lists, hyperlinks, tables, web forms, inserting images, frames, hosting options and domain name registration.

UNIT-IV: 10hrs

Style Sheets: CSS-Introduction to Cascading Style Sheets-Features-Core Syntax-StyleSheets and HTML Style Rule Cascading and Inheritance-Text Properties-Box Model-Normal Flow Box Layout-Beyond the Normal Flow-Other Properties-Case Study.

Client-Side Programming: The JavaScript Language-History and Versions Introduction to JavaScript in Perspective-Syntax-Variables and Data Types-Statements-Operators-Literals-Functions-Objects-Arrays-Built-in Objects-JavaScript Debuggers.

Text Book:

1.J. A. Ramalho, Learn Advanced HTML 4.0 with DHTML, BPB Publications,2007

Reference Books:

1.B. A. Forouzan, Data Communication and Networking ,5th Edition, Tata McGrawHill, 2008.

2.D.R. Brooks, An Introduction to HTML and Javascript for Scientists and Engineers, 1st Edition,Springer, 2007.
3.Wendy Willard, HTML A Beginner's Guide, 4th Edition, Tata McGraw-Hill Education.
4.J. A. Ramalho, Learn Advanced HTML 4.0 with DHTML, 1st Edition, BPB Publications

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Understand the fundamental concepts of Computer networks with architecture.
CO2	Basic Concept of various Network Devices
CO3	Understand the basic concept of transmission media, LAN topology.
CO4	Understand Fundamentals of Web Design
CO5	Develop Web Applications using Web Technologies

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PS1**	**PS2**	**PS3**
CO1	2	2	2	1	2	1	1	2	2	1
CO2	2	2	2	1	2	1	2	2	2	1
CO3	2	2	2	2	2	1	2	2	2	1
CO4	2	2	2	1	2	1	2	2	2	2
CO5	2	2	2	1	2	1	3	2	2	2

Course Code	**CSC306B**
Course Name	**FUNDAMENTALS OF COMPUTER**
Category	IDSE course
Prerequisite	Basic Mathematics

IDSEPaper-CSC306B

FUNDAMENTALS OF COMPUTER

UNIT-I: 10hrs

Computer Basics: Simple model of computer, Problem solving using computer(flowchart, program, working of a computer, hardware and software). **Data Representation**: Character representation, representation of integers and fractions, Decimal to Binary conversion. Input / Output Units.

UNIT-II: 10hrs

Memory System : Basics concepts (RAM, ROM, Speed, Size and Cost) Cache Memory concepts, Cache Memory mapping technique, Virtual Memory concepts, Secondary Storage, Processor: Structure of Instructions, Description of a processor, Machine Language program, Algorithm to simulate the hypothetical computer.

UNIT-III: 10hrs

Binary Arithmetic: Addition, Subtraction, Signed numbers, Two's complement representation of numbers, Addition/ Subtraction of numbers in 2's complement notation, binary multiplication, binary division, floating point representation of numbers, arithmetic operation with normalized floating point numbers.

UNIT-IV: 10hrs

Logic circuit: Switching circuits, AND, OR, NOT operation, Boolean functions, canonical forms of Boolean function, Logic circuits, **Computer Architecture** : Interconnection of Units, Processor to Memory communication, I/O devices to processor communication, Bus Architecture of personal Computers. **Introduction to Programming Language, Operating System.**

Text Books:

1. V.Rajaraman and N.Adabala, Fundamental of Computers,PHI, 2014
2. A.Goel, Computer Fundamentals, Pearson Education,2010

Reference Books:

1. P.Aksoy, L.DeNardis, Introduction to Information Technology, Cengage Learning,2006.

2. P.K.Sinha, P.Sinha, Fundamental of Computers, 8th Edition ,BPB Publishers,2007.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Describe the basic of computer.
CO2	Classify the architectural level of the system
CO3	Explain the memory and its related concepts of the system.
CO4	Evaluates the complements of the numbers both for positive and negative numbers.
CO5	Discuss the concepts of Programming languages and its basic classifications.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PS1**	**PS2**	**PS3**
CO1	2	1	1	1	2	1	1	1	1	1
CO2	2	1	1	1	2	1	1	1	1	1
CO3	2	1	1	1	2	1	1	1	1	1
CO4	2	1	1	1	2	1	1	1	1	1
CO5	2	2	2	1	2	1	2	2	2	2

Course Code	**CSC306C**
Course Name	**INTRODUCTION TO PROGRAMMING USING PYTHON**
Category	IDSE course
Prerequisite	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with any other programming language will be beneficial.

IDSE Paper-CSC306C

INTRODUCTION TO PROGRAMMING USING PYTHON

UNIT-I: **10hrs**

Introduction: Installation, First python Program: Interactive Mode Programming, Script Mode Programming, Identifiers, Reserved words, Lines and Indentation, Multi-Line Statements, Quotation &Comments,; Assigning values to Variables, Multiple Assignment.

UNIT-II: **10hrs**

Standard Data Types: Numbers, Strings, Lists, Tuples, Dictionary; Data type conversion; **Basic Operators:** Arithmetic, Comparison, Assignment, Bitwise; Operators: Logical, Membership, Identity; Operators Precedence; Python Numbers & Mathematical functions. **Data type conversion:** Basic operators: Arithmetic, Comparison, Assignment, Bitwise; Basic Operators, Python Numbers & Mathematical functions, Python Strings.

UNIT-III: **12hrs**

Python Statement and Loops: if, if-else, while, for loop, break, continue, pass, python function; Files I/O.

Functions: Definition, call, positional and keyword parameter, Default parameters, variable number of arguments, Modules – import mechanisms, Functional programming – map, filter, reduce, max, min, lambda function – list comprehension.

UNIT-IV: **08hrs**

Object Oriented Programming : classes and objects, Inheritance –Polymorphism overloading, Error handling and Exceptions – try, except and raise- exception propagation

File Processing : reading and writing files.

Text Books:

1. Nischay Kumar Hegde ,Python Programming Fundamentals – A Beginner's Handbook, 1st Edition, Educreation Publishing.

Reference Books:

1. Martin C. Brown ,The Complete Reference :Python.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Operate the installation of the software and its operation.
CO2	Memorize the programming elements of the Python language.
CO3	Break down the real world problems and model them using the data structures available in Python.
CO4	Design the programs using conditional and loop structures used in Python.
CO5	Explore the reusable structures in Python and compare this language with other languages to see its benefits.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3				1		1	1	1	1
CO2	3		2	1	1		1	2	1	2
CO3	3		3	2	2		2	3	2	3
CO4	3		3	3	2		3	3	2	3
CO5	3		3	3	2		3	3	3	3

Course Code	CSC 306D
Course Name:	**ARTIFICIAL INTELLIGENCE**
Category:	IDSE Course
Prerequisite:	Linear Algebra, Programming Language

Paper-CSC306D

Artificial Intelligence

UNIT-I: 10hrs

Introduction to Artificial Intelligence, AI Problems, AI Techniques,Problems ,Problem Space and Search, Defining the problem as a state space search, Production system, Problem characteristics, **Heuristic search Technologies:** Generate and Test, Hill Climbing, Best First Search, Problem Reduction, means-end-analysis, optimal and A*,AND-OR Graphs, AO* Algorithms.

UNIT-II: 10hrs

Representation Knowledge using Predicate Logic, Representing simple facts in logic, Representing Instance and ISA relationships, Computable functions and Predicates, Resolution, Representing Knowledge using Rules, Forward Vs Backward Reasoning, Matching , Control Knowledge, Weak slot and Filter structures, Semantic nets, Frames

UNIT-III: 10hrs

Strong slot and Filter structures, Conceptual Dependencies, Scripts. Introduction to Non monotonic reasoning ,Logics for Non monotonic reasoning, Implementation : Depth First Search, Dependency-Directed Back Tracking, Justification based Truth Maintenance Logic based Truth Maintenance systems,Statistical Reasoning, Probability and Bayes Theorem,Certainty factors, Rule based Systems, Beyesian Networks, Dempster-Shaffer Theory

UNIT-IV: 10hrs

Minmax search, alpha-beta cutoffs, Planning system, Goal stack planning, Hierarchical Planning, Natural Language Processing., Syntactic Analysis, Semantic Analysis, Discuses and Pragmatic Processing. Introduction and Fundamentals of Artificial Neural Networks, Biological Prototype, Artificial Neuron, Single Layer Artificial Neural Networks, Multilayer Artificial Neural Networks, Training of Artificial Neural Networks, Genetic Algorithms

Text Books:

1.Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence,3rd Edition, McGraw Hill, ,2009.
2.Waserman ,Neural Computing: Theory and Practice.

Reference Books:

1. George F. Lugar ,Artificial Intelligence: Structures and Strategies for Complex Problem Solving,6thEdition,Pearson Education
2. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Pearson Education, 2010.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI.
4. Simon Haykin,Neural Networks: A Comprehensive Foundation ,2nd Edition, Pearson Education.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Explore agents, environments, and search goal state using uninformed techniques in a state space.
CO2	Interpret logic, inference rules for decision making, and represent knowledge using semantic nets & frames.
CO3	Apply planning and reasoning to handle uncertainty in real life problems.
CO4	Design expert systems. to solve complex real-life problems.
CO5	Apply neural network and genetic algorithm to solve various mathematical and engineering problems.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3		2		2			1	1	1
CO2	3		3		3			3	3	3
CO3	3		3		3			3	3	3
CO4	3		3		3			3	3	3
CO5	3		3		3			3	3	3

Semester-IV

Course Code:	**CSC401**
Course Name:	**MACHINE LEARNING**
Category:	Programme Core Course
Prerequisite:	Basic knowledge of Mathematics

Paper-CSC401

Machine Learning

UNIT-I: **10hrs**

Introduction to machine Learning ((Supervised, Unsupervised and Reinforcement learning), Learning Models (Classification, Regression, Clustering).
Cluster Analysis, Partitioning Methods (k-Means, k-Medoids), Hierarchical Methods, Density-Based Methods, Evaluation of Clustering.

UNIT-II: **10hrs**

Conditional Probability, Bayes' Theorem, Naïve Bayes Classifier, K-nearest neighbour, Multiple linear regression, Shrinkage method, Ridge regression, Logistic regression, Linear Discriminant Analysis.

UNIT-III: **10hrs**

Neural Networks - Introduction, McP Neural Network, Perceptron Learning, Neural Networks - Backpropagation, Neural Networks - Initialization, Training & Validation. Decision Tree, Decision Tree Induction, Attribute Selection Measures, Information Gain, Gain Ratio, ID3, C4.5, Gini Index, CART.

UNIT-IV: **10hrs**

Support Vector Machine for linearly separable data, Kernel function, Support Vector Machine for linearly non-separable data.
Dimensionality reduction, Feature selection, Feature extraction, Principal Component Analysis.Model Cross- validation, Performance of Classification algorithms (Confusion Matrix, Precision and Recall).

Text Books:

1. T. Hastie, R. Tibshirani,and J. Friedman , The Elements of Statistical Learning-Data Mining, Inference, and Prediction, 2nd Edition, Springer Verlag, 2009.
2. S. Haykin, Neural Networks and Learning Machines, 3rdEdition,Pearson Education, 2009.

Reference Books:

1. Y. G. James, D. Witten, T. Hastieand R. Tibshirani, An introduction to Statistical learning with Applications in R, Springer, 2013.
2. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Explain the concepts of supervised machine learning and its functionalities.
CO2	Perform classification using Bayes classifier, SVM, Decision Tree, and Random Forest.
CO3	Reduce dimension of feature space using feature selection and feature extraction.
CO4	Explain the concepts of unsupervised machine learning and its functionalities.
CO5	Apply supervised and unsupervised machine learning methods to solve real life problems.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3		3		3			3	3	3
CO2	3		3		3			3	3	3
CO3	3		3		3			3	3	3
CO4	3		3		3			3	3	3
CO5	3		3		3			3	3	3

Course Code	**CSC402**
Course Name	**SOFTWARE ENGINEERING AND OOAD**
Category	Programme Core Course
Prerequisite	Knowledge of software, object oriented concept and databases

Paper-CSC402

Software Engineering and OOAD

UNIT-I: **10 hrs**

Introduction to Software and Software Engineering: Basic concepts about software and program, the nature of software, Evolution of Software Engineering, Stakeholders in software engineering, Software quality, Software engineering projects, Activities common to software projects, Basic concepts on process and life cycle models.
Models: Waterfall, Prototype, Evolutionary, Incremental, Spiral, Agile, V-model

UNIT-II: **08hrs**

Requirement Analysis: System and software requirements, Types of software requirements, Functional and non-functional requirements, Domain requirements, User requirement Elicitation and analysis of requirements, Overview of requirement techniques, Viewpoints, Interviewing, Scenario, Requirement validation, Requirement specification, Software requirement Specification (SRS)Structure and contents, SRS format.

UNIT-III: **10hrs**

Introduction to Object Oriented Technology: Development and OO Modelling History, Modelling Concepts.
Object Oriented Analysis: Identifying Use-Cases, Complexity in Object Oriented Analysis, Business Process Modelling and Business Object Analysis, Use-Case Driven Object-Oriented Analysis, Use-Case Model.

Class Modelling: Object and class concepts, link and association, Generalization and Inheritance, Advanced class modelling- aggregation, state diagram, state diagram behaviour, Relation of Class and State models. Interaction Modelling: Sequence models, Activity Diagrams.
UNIT-IV: 12hrs
Software Project Management: Overview of Project Management, Responsibilities of Project Manager, Project Planning, Metrics for Project Size Estimation, Factors Influencing Project Management, Project Estimation Techniques, COCOMO Model, Scheduling, Work Breakdown Structures (WBS), Activity Network, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), GANTT Chart, Risk Management. **Software Testing**: Testing overview, concepts, Scope of Testing, Testing Constraints, Testing Life Cycle, Levels of Testing, System Testing, Blackbox Testing, Whitebox Testing, Integration Testing, Acceptance Testing, Performance Testing (Load testing, Stress testing, Scalability Testing, Stability Testing, Volume Testing, Smoke Testing). Basic Concepts of Regression Testing(Need of Regression Testing, How to perform Regression Testing, Testing Tools).
Text Books:
1.R. Mall, Fundamentals of Software Engineering, 5th Edition, PHI, 2019. 2.R.S. Pressman, Software Engineering, A Practitioner's Approach, 7th Edition, McGraw-Hill, 2009 3.Timothy C. Lethbridge, Robert Laganière, Object-Oriented Software Engineering Practical Software development using UML and Java,2nd Edition, McGraw-Hill.
Reference Books:
1.Sommerville, Software Engineering, 9th Edition, Addison Wesley.

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Define software terminologies, and generic view of the software engineering process.
CO2	Describe the SDLC phases and apply suitable life-cycle model in building of software products based on their characteristics.
CO3	Apply object oriented analysis and design to build a software system.
CO4	Explain the scheduling, project management tasks and design artefacts.
CO5	Summarize different testing strategies and implement them appropriately.

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	1	2	3	2	1			2		1
CO2	2	1		2		2			2	
CO3	2	3	2		3			3		2
CO4	1	3	1	1			3		1	
CO5	3	3	3		2	1		3		3

Course Code	**CSC403**
Course Name	**CLOUD COMPUTING**
Category	Programme Core Course
Prerequisite	Computer Networks and Operating Systems

Paper-CSC403

Cloud Computing

UNIT-I: **8hrs**

Distributed System Models and Enabling Technologies: scalable computing over the Internet, technologies for network-based systems, system models for distributed and cloud computing, software environments for distributed systems and clouds, performance, security, and energy efficiency.

UNIT-II: **8hrs**

Virtual Machines and Virtualization of Clusters and Data Centers: implementation levels of virtualization, virtualization structures/tools and mechanisms, virtualization of CPU, memory and I/O devices, virtual clusters and resource management, virtualization of data-center automation.

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UNIT-III: **10hrs**

Cloud Platform Architecture over Virtualized Data Centers: cloud computing and service models, data-center design and interconnection networks, architecture design of compute and storage clouds, public cloud platforms: GAE, AWS (EC2 and S3) and Azure,inter-cloud resource management, cloud security and trust management.

UNIT-IV: **14hrs**

Cloud Programming and Software Environments: features of cloud and grid platforms, parallel and distributed programming paradigms, programming support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, emerging cloud software environments

Advanced Topics in Cloud Computing and Applications: Energy efficiency in clouds, market-based management of clouds, federated clouds/intercloud, third-party cloud services, scientific applications: healthcare, biology, geoscience and business and consumer applications.

Text Books:

1.Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet", 1st Edition, Morgan Kaufman Publisher, an imprint of Elsevier, 2012.

2.RajkumarBuyya, Christian Vecchiola and S. ThamaraiSelvi, "Mastering Cloud Computing: Foundations and Applications Programming, MK Publisher, Elsevier, 2013

Reference Books:

1.Tom White, HadoopThe Definitive Guide, 4thEdition. O'Reilly, 2009.
2.Ian Foster, Carl Kesselman,The Grid: Blueprint for a New Computing Infrastructure, 2nd Edition, Morgan Kaufmann.

3..P. K. Pattnaik, M. R. Kabat and S. Pal, Fundamentals of Cloud Computing, Vikas Publishing House Pvt. Ltd., 2015

	COURSE OUTCOMES: After completion of this course successfully, the students will be able to-
CO1	Ability to understand various service delivery models of a cloud computing architecture
CO2	Describe the concepts of service-oriented architecture
CO3	Analyze the different workflows of service-oriented architecture
CO4	Ability to understand the security challenges and address the challenges
CO5	Understand the ways in which the cloud can be programmed and deployed

Mapping of COs to POs (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	1	2	2	2		1	3	3	3
CO2	3	3	1	1	3		2	2	2	2
CO3	2	2	3	3	1		2	3	2	1
CO4	1	2	1	2	2		3	2	3	3
CO5	2	1	2	1	3		2	2	1	2

Paper-CSC404

Project Work Report and VIVA VOCE

Web-development project: Students must follow software engineering principles to make the project.
Research project: Students can take a research work, review the related literatures, then propose a method or implement an existing one.

MOOCs-1/MOOCs-2

Students are required to complete any **two** of the following MOOCs courses to earn a maximum of 6 credits duration anytime during his/her entire two years of MSc. Computer Science from**https://swayam.gov.in**. as well as **https://nptel.ac.in**.The course completion certificate of below said courses need to be submitted in the final year at the time of Project Viva.

1.An Introduction to Coding Theory	2.Big Data Computing
3. Computer Graphics	4. Applied Natural Language Processing
5.An Introduction to Artificial Intelligence	6.Google Cloud Computing Foundations
7. AI: Knowledge Representation and Reasoning	8.Probability for Computer Science
9. R	10.Computer Application in Business
11.Peer to Peer Networks	12.Animations
13. Parallel Algorithms	14. Distributed Computing systems
15.Pattern Recognition	16.Real Time Systems
17.Blockchain Architecture Design and use cases	18.Computational Complexity Theory
19.Deep learning	20.Data Analytics with Python
21.Embedded System Design	22.Android app using Kotlin
23.Introduction to Haskell programming	24. Human-Computer Interaction
25.Arduino	26.Software Project Management
27.Introduction to Soft computing	28.Computer Vision
29.Switching Circuits and Logic Design	30.Virtual Reality

Apart from the above courses if any student wishes to do any course fromhttps://swayam.gov.in.aswellas https://nptel.ac.in(but it should not be taught in their course curriculum of 1st, 2nd , 3rd,4th Semesters) they are allowed to do so with a prior approval of HOD, Computer Science.