BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA
ROURKELA

Curriculum and Syllabus

M.Sc (Computer Science)
for the Admission Batch 2022-23

M.Sc. in Computer Science
(Admission Batch : 2022-23)

1st Semester

First Semester					
Theory					
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	PC	MSCS101	Programming with JAVA	3-0-0	3
2	PC	MSCS102	Computer Organization and Architecture	3-0-0	3
3	PC	MSCS103	Data Structures and Algorithms	3-0-0	3
4	PC	MSCS104	Database Management Systems	3-0-0	3
5	HS	HSCS105	Discrete Mathematics	3-0-0	3
Total Credit (Theory)					**15**
Practical					
1	PC	MSCS150	Data Structures and Algorithm Lab.	0-0-3	2
2	PC	MSCS151	DBMS Lab.	0-0-3	2
3	PC	MSCS152	JAVA Lab.	0-0-3	2
4	MC	MCCS153	Yoga	1-0-0	1
Total Credit (Practical)					**7**
Total Semester Credit					**22**

2nd Semester

Second Semester					
Theory					
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	PC	MSCS201	Operating Systems	3-0-0	3
2	PC	MSCS202	Internet and Web Technology	3-0-0	3
3	PC	MSCS203	Software Engineering and OOAD	3-0-0	3
4	PC	MSCS204	Computer Network	3-0-0	3
5	PE	MSCS205 MSCS206 MSCS207	Data Warehousing and Mining Wireless Sensor Network Mobile Computing	3-0-0	3
6	HS	HSCS208	Environmental Science	1-0-0	1
Total Credit (Theory)					**16**
Practical					
1	PC	MSCS250	Internet and Web Technology Lab.	0-0-3	2
2	PC	MSCS251	Software Engineering Lab.	0-0-3	2
3	PC	MSCS252	Computer Network Lab.	0-0-3	2
Total Credit (Practical)					**6**
Total Semester Credit					**22**

3rd Semester

Third Semester					
Theory					
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	PC	MSCS301	Compiler Design	3-0-0	3
2	PC	MSCS302	Artificial Intelligence and Machine Learning	3-0-0	3
3	PC	MSCS303	Cloud Computing	3-0-0	3
4	PC	MSCS304	Information Security	3-0-0	3
5	PE	MSCS305 MSCS306 MSCS307	Big Data Analytics Internet of Things Embedded Systems	3-0-0	3
Total Credit (Theory)					**15**
Practical					
1	PC	MSCS350	Information Security Lab.	0-0-3	2
2	PC	MSCS351	AI & ML Lab.	0-0-3	2
3	PC	MSCS352	Cloud Computing Lab.	0-0-3	2
4		MSCS353	Seminar and Technical Writing	0-0-2	1
Total Credit (Practical)					**7**
Total Semester Credit					**22**

4th Semester

Fourth Semester					
Theory					
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	PC	MSCS450	Dissertation Evaluation and Open Defence		12
2	PC	MSCS451	Comprehensive Viva – Voce		4
3			MOOCS -1 (08 – 12 Weeks)*		3
4			MOOCS -2 (08 – 12 Weeks)*		3
Total Credit (Theory)					**16+6***

* The MOOCs courses can be taken by the student in any semester from second semester onwards. However, these two courses must be completed before the final declaration of result.

1st Semester

MSCS101 PROGRAMMING WITH JAVA (3-0-0)

Module-I (10 Periods)
JAVA BASICS: Concept of Object oriented Paradigm, History of Java, Java buzzwords, JVM architecture, simple java program, Data types, Variables, Scope and life time of variables, final variable, operators, control statements, type conversion and casting, arrays, methods, Static block, Static Data, Static Method, User defined class, constructors, Use of this keyword, Object class, Scanner class, String and String Buffer Classes, Package, Wrapper class.

Module-II (10 Periods)
INHERITANCE AND POLYMORPHISM: Basic concepts, Types of inheritance, Member access rules, Method Overloading, Method overriding ,Usage of this and Super key word, Dynamic method dispatch, final class, final method.
Abstraction: Abstract classes, Usage of final keyword, Interface concept: Defining and Implementing interfaces, Multiple Inheritance through interfaces.
EXCEPTION HANDLING: Exception types, Usage of Try, Catch, Throw, Throws and Finally keywords, Built-in Exceptions, Creating own Exception classes

Module-III (10 Periods)
MULTI THREADING: Concepts of Thread, Thread life cycle, creating threads using Thread class and Runnable interface, Thread priorities, Synchronization, Inter Thread communication.
I / O : Concepts of streams, Difference between binary Io and Character IO, Stream classes- Byte and Character stream, Reading console Input and Writing Console output, File Handling,
Collections: Collections hierarchy, ArrayList, Array vs ArrayList.

Module-IV (10 Periods)
GUI Programming: AWT Vs Swing, AWT class hierarchy, Swing class hierarchy user interface components- Labels, Button, Text Components, Check Box, Check Box Group, Choice, List Box, Panels – Scroll Pane, Menu, Scroll Bar. Working with Frame class and JFrame class, Colour, Fonts and layout managers. EVENT HANDLING: Event Delegation Model (EDM),Events, Event sources, Event Listeners, , Handling Action Event, Mouse, Keyboard and Window Events, Adapter classes, Inner classes.
DialogBoxes, JList, JComboBox
Database Programming: JDBC concept, Types of Drivers, Connection, Statement, Prepared Statement, Resultset, Web programming using applet, Basics of Server side programming, Servlet.

Books:
1. Herbert schildt (2010), The complete reference, 7th edition, Tata Mc graw Hill, New Delhi
2. Liang Y. Daniel, Introduction to Java Programming, 7th Edition, 2009, Pearson Education

Reference Book
1. Head First Java, O'rielly publications

MSCS102 COMPUTER ORGANIZATION AND ARCHITECTURE (3-0-0)

Module – I: (10 Hours)
Introduction: Basic architecture of computer, Functional units, Operational concepts, Bus structures,Von Neumann Concept. Basic Processing: Instruction code, Instruction set, Instruction sequencing, Instruction Cycle & Execution Cycle, Instruction format, Addressing modes, Micro instruction, Data path and control path design, Micro programmed vs. Hardwired controlled unit, RISC vs. CISC. Arithmetic: Design of ALU, Number systems, Binary numbers, Sign Magnitude & 2's complement representation. Fixed and Floating point, IEEE-754 Single Precision format, IEEE-754 Double Precision format, Precision and range, BCD code, ASCII, and EBCDIC, Addition and Subtraction of signed number, Multiplication of Positive number, Signed operand multiplication, Division, Floating point number representation and arithmetic, Digital Electronics: Boolean algebra, Digital Logic gates, Truth Tables, K map, Combinational circuits, Flip - Flop

Module – II: (10 Hours)
Pipelining: Basic concepts, Instruction and Arithmetic pipeline, Data hazards, Control hazards and Structural hazards, Techniques for handling hazards, Pipeline optimization techniques, Input-Output devices and characteristics, Input-output mechanism: Memory-mapped I/O, Programmed I/O, Interrupts, Direct Memory Access. Basic Multiprocessor Architecture: Flynn's Classification, UMA, NUMA, Distributed Memory Architecture, Array Processor, Vector Processors.

Module – III: (10 Hours)
Memory: Memory Hierarchy, RAM, ROM, Secondary Storage, Flash drives. Programmable Logic Devices- PLA, PAL, ROM. Sequential RTL components: Registers counters, Inclusion, Coherence and locality properties, Cache memory organizations, Data and Instruction caches, Multi-level caches, Cache memory mapping policies, Cache Coherence, Cache Performance, Techniques for reducing cache misses, Mapping techniques, Virtual memory, Memory Interleaving, Virtual memory organization, Mapping and Management techniques, Memory replacement policies, Memory Management hardware

Module – IV: (10 Hours)
General Register Organization, Stack Organization, Reverse Polish Notation, Machine Language instructions, addressing modes, Instruction types, Instruction set selection, Instruction cycle and execution cycle.8085 Microprocessor and Fundamental of assembly language Programming using 8085 microprocessor, Interconnection Networks: Static Networks, Dynamic Networks, Network Topologies.

Text Books:
1. Mano. M. "Computer System and Architecture" (3rd Ed) (PHI).
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGraw Hill, 2002.
3. Fundamentals of Computer Organisation by M V L N Raja Rao; Scitech publ.
4. Digital Electronics: Principles and Integrated Circuits Anil K. Maini ,Wiley

Reference Books:
1. David A. Patterson and John L. Hennessy, Computer Organization and Design, Elsevier.
2. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw- Hill.
3. William Stalling,"Computer Organization and Architecture", Pearson Education
4. A.S. Tananbaum, "Structured Computer Organization", Pearson Education

MSCS103 DATA STRUCTURES AND ALGORITHMS (3-0-0)

MODULE-I: (10 Periods):
Asymptotic Notations. Analysis of few Non-Recursive and Recursive Algorithms. Recurrences: The Master method, The Iteration method, Recursion Tree.
Linked Lists: Singly linked lists, Doubly linked list, Circular linked list, Representation of Polynomial and Sparse matrix.

MODULE-II: (10 Periods)
Stack and Queues: Prefix, infix and postfix expression, Circular Queue, Priority Queue.
Tree and Graph: Tree Terminologies and memory representation, Binary Tree Traversal, Binary search Tree, AVL Trees, B-Trees. Graph Representation, Graph traversal (BFS, DFS).

MODULE-III: (10 Periods)
Divide and conquer methodology: Binary search, Merge sort, Quick sort, Heap Sort, Multiplication of large Integers.
Greedy Techniques: Single source shortest paths (Bellman-Ford and Dijkstra's algorithm), Minimal spanning tree (Kruskal and Prim's algorithms), Huffman trees.
String matching Algorithm: Naïve, Rabbin-Karp string matching algorithm.

MODULE-IV: (10 Periods)
Dynamic Programming Paradigm: Matrix Chain Multiplication Problem, Longest Common Subsequence Problem, Optimal binary search Tree.
Backtracking: N-Queen's problem, Subset-Sum problem. State Space Search Tree for these problems. Branch and Bound: Assignment problem, Travelling Sales Person problem. State space search tree for these problems.

Books:
1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", PHI Publication.
2. Anany V. Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education Inc., New Delhi.
3. Data Structures Using C - Aaron M. Tenenbaum

MSCS104 DATABASE MANAGEMENT SYSTEMS (3-0-0)

Module-1 (10 Hours)
Introduction and overview of DBMS. Comparison of Database Systems with file systems. Database users and Administrators, DB Languages, 3-schema Architecture and Data Independence.
Conceptual Modelling: ER Model - Entity types, Key, Relationship types and constraints, Weak Entity types and its relationship, ER Diagram, Extended ER Features.

Module-2 (10 Hours)
EF Codd rules. Relational Model, its structure, keys, Integrity constraints, Conversion of ER Model to Relational Model, Relational Algebra, Tuple Relational Calculus.
Relational Database Design: Functional Dependencies, closure, cover, equivalent set of FDs, Minimal cover.
Module 3 (10 Hours)
Relational Database Design (Contd.)- Normalization- Aim, 1NF,2NF,3NF, BCNF, Decomposition using FDs, Lossless and Dependency Preserving Scheme of Decomposition, MVD and 4NF, JD and 5NF.
Query Optimization: Various Optimization Algorithms, Transforming Relational Algebra into Query trees. Heuristic Optimization Rules.

Module 4 (10 Hours)
SQL - DDL, DML, DCL, Constraints, keys, set operations, Aggregate Functions, Group by, Join and its Types, Sub Query, Views, PL/SQL-Cursor, Trigger.
Transaction Concepts: Properties, Problems with concurrent Transactions, Concurrency Control, Serializability, Testing for serializability, Cascade less and Recoverable schedules, 2 Phase Locking Protocol and its Variations, Deadlocks, Recovery Management

Advanced Database (Outline) : OODB, WEB DB, Data Warehousing and Data Mining

Text Books:
1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, “Database Systems Concepts”, McGraw-Hill Education , New Delhi
2. RamezElmasri and Shamkant B. Navathe, “Fundamentals of Database Systems”, Pearson Education Inc., New Delhi.

Reference Books:
1. Hector Garcia-Molina, Jeffret D. Ullman, Jenniffer Widom, “Database Systems: A Complete Book”, Pearson Education Inc., New Delhi.
2. C. J. Date “An introduction to Database System”, Pearson Education Inc., New Delhi.
3. Bipin Desai, “An introduction to Database System”, Galgotia Publications.
4. Peter Rob & Carlos Coronel, “Database Systems: Design, Implementation, and Management”, CENGAGE Learning India Pvt. Ltd., New Delhi.
5. Mark L. Gillenson, “Fundamentals of Database Management Systems”, Wiley India Pvt. Ltd., New delhi.
6. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, McGraw-Hill Education (India), New Delhi.

HSCS105 DISCRETE MATHEMATICS (3-0-0)

Module I (10 Period)
logic: Proposition and logical operation, conditional statement, methods of proof, mathematical induction. Counting principle: permutation and combination, Principle of inclusion and exclusion, pigeonhole principle, recurrence relations.

Module II (10 Period)
Relations and diagraph: Properties of relations, Equivalence relations, closure properties of relations, Transitive closure by Warshall's Algorithm. Functions, Partially Ordered Sets, Hass diagram, lattice, finite Boolean algebra.

Module III (10 Period)
Graph theory: Graph, Euler Paths and Circuit, Hamiltonian Paths and Circuit, Planner Graphs, Coloring of graphs. Trees: Undirected Trees, Tree searching , Minimal Spanning trees. Single source shortest path.

Module IV (10 Period)
Groups: Binary operation, Semi groups, Groups and Subgroups, cosets and Lagrange's Theorem. Groups and Coding: Coding of binary information and error detection, Decoding and error correction.

Text Books

1. B. Kolman. R C Bosby. S Ross , " Discrete mathematical structure " PHI
2. C.L Liu , " Elements of Discrete mathematics" Mc Graw hill international
3. Kenneth H Rosen, "Discrete mathematics and its applications" , Mc Graw hill international.

MSCS150 DATA STRUCTURES AND ALGORITHM LAB. (0-0-3)

1. Implementation of Stack and Queue – Operations and Applications.
2. Implementation of different searching algorithms.
3. Implementation of different sorting algorithms.
4. Problem solving using Divide and Conquer technique.
5. Problem solving using Dynamic Programming technique.
6. Problem solving using Greedy technique.
7. Problem solving using Backtracking technique.
8. Problem solving using disjoint-set data structure operations.
9. Problem solving using Branch and Bound technique.
10. Problem solving for the Maximum Flow problem.
11. Implementation of Graph Traversal algorithms – Breadth-First-Search (BFS) and Depth-First-Search (DFS).
12. Implementation of Minimum Spanning Tree construction algorithms – Kruskal and Prim.
13. Implementation of different String-Matching algorithms.
14. Problem solving for the Shortest Path problem using different algorithms.
15. Problem solving using Approximation algorithms.

MSCS151 DBMS LAB. (0-0-3)

List of Experiments:

1. Creation and Modification of a database and imposing constraints.
2. Implementing DML Statements.
3. Queries to retrieve Information from the database using different conditions.
4. Executing single line and group functions for a table.
5. Implementing Group by and joins
6. Implementing Sub Queries
7. Creating Views
8. Creating Indexes, Sequences and Synonyms
9. Executing DCL and TCL Commands.
10. Creating a mini Database for a company considering Employee, Department, Projects, Dependents etc.
11. Study of PL/SQL Block Structure
12. Exception Handling in PL/SQL
13. Implementing Cursors
14. Creation of Procedures and functions.
15. Creation of Packages
16. Creation of Database Triggers
17. Creating Forms
18. Generating Reports

MSCS152 JAVA LAB. (0-0-3)

1. Introduction, Compiling & executing a java program.
2. Data types & variables, decision control structures: if. nested If etc.
3. Loop control structures: do while, for etc.
4. Classes and objects.
5. Data abstraction & data hiding. Inheritance, polymorphisrn.
6. Threads, exception handlings and applet programs
7. Interfaces and inner classes, wrapper classes generics

2nd Semester

Second Semester					
Theory					
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	PC	MSCS201	Operating Systems	3-0-0	3
2	PC	MSCS202	Internet and Web Technology	3-0-0	3
3	PC	MSCS203	Software Engineering and OOAD	3-0-0	3
4	PC	MSCS204	Computer Network	3-0-0	3
5	PE	MSCS205 MSCS206 MSCS207	Data Warehousing and Mining Wireless Sensor Network Mobile Computing	3-0-0	3
6	HS	HSCS208	Environmental Science	1-0-0	1
Total Credit (Theory)					**16**
Practical					
1	PC	MSCS250	Internet and Web Technology Lab.	0-0-3	2
2	PC	MSCS251	Software Engineering Lab.	0-0-3	2
3	PC	MSCS252	Computer Network Lab.	0-0-3	2
Total Credit (Practical)					**6**
Total Semester Credit					**22**

2nd Semester

MSCS201 OPERATING SYSTEMS (3-0-0)

Module I: 9 Hours

Introduction: concept of operating system, types of OS,OS services, System calls and their types, system structure of operating system.

Process Management: process concepts, states, PCB, types of schedulers, operations on process, inter-process communication, concept of buffering

Module II: 9 Hours

Thread overview, user & kernel threads, multi-threading models, issues with multi-threading; CPU Scheduling: scheduling criteria, scheduling algorithms: FCFS, SJF, SRTF, RR, Priority Scheduling, MLQ, and MLQ with Feedback Scheduling.

Critical Section Problem, Solution to Critical Section problem, Dekker's Algorithm, Peterson Algorithm, synchronization hardware

Module III: 9 Hours

Semaphores; Classical problems of synchronization: Bounded-Buffer problem, Readers-Writers Problem, Dining-Philosophers Problem

Deadlock: characterization, prevention, avoidance, Banker's algorithm, deadlock detection and recovery.

Module IV: 9Hours

Memory Management: Logical and physical address space, dynamic loading and linking, swapping, Non Contiguous Memory Allocation: Paging, Segmentation;

Virtual Memory Management: Demand paging, page fault, basic page replacement policy, Page Replacement Algorithms: FIFO, OPT, LRU, LFU, MFU, Thrashing, working-set model.

Secondary Storage Structure: Overview of mass storage structure, disk structure; Disk Scheduling: FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK,

Text Books:

1. A. Silberschatz, P. B Galvin, and G Gagne, Operating Systems Principles,9th Edition, Wiley India, 2019.
2. William Stallings, "Operating Systems Internals & Design Principles", 9th Edition, Pearson Education, 2018.

Reference Books:

1. A. S. Tanenbaum, Modern Operating Systems, 4th Edition, PHI Learning, 2018.
2. P. B. Prasad, Operating Systems and System Programming, 3rd Edition,SciTech Publishers, 2018.

MSCS202 INTERNET AND WEB TECHNOLOGY (3-0-0)

Module I: 9 Hours

Internet Architecture: Internet overview, ISPs, TCP/IP model, TCP/IP vs OSI model. Introduction to PHP: Declaring variables, data types, arrays, strings, operators, expressions, control structures, functions, Reading data from web form controls like text boxes, radio buttons, lists etc., File Handling

Connecting to database (MySQL as reference), executing simple queries, handling results, Handling sessions and cookies.

Module II: 9 Hours

HTML: HTML Overview, Structure of HTML Documents, Document Types, HTML Elements and attributes. Anchor Attributes, Image Tag and its attributes, Image and Anchors, Table.

Image Map: Attributes, Client Side Image Maps and Server Side Maps.HTML Layout: Background, colors and text, Tables, Frames, Layers, Page content Division<Div>, <SPAN>. CSS: Style Sheet Basic, Properties, Positioning with Style Sheet. Forms: <FORM> Elements, Form controls. Dynamic HTML.

Module III: 9 Hours

Java Script: Introduction, Client-Side JavaScript, Server-Side JavaScript, JavaScript Objects, JavaScript Security. Operators: Assignment Operators, Comparison Operators, Arithmetic Operators, Increment, Decrement, Unary Negation, Logical Operators, String Operators, Special Operators, Conditional operator, Comma operator, delete, new, this, void. Statements: Break, comment, continue, delete, do ... while, export, for, for...in, function, if...else, import, labelled, return, switch, var, while. JavaScript (Properties and Methods of Each) :Array, Boolean, Date, Function, Math, Number, Object, String, regExp. Document and its associated objects, document, Link, Area, Anchor, Image, Applet, Layer. Events and Event Handlers: General Information about Events, Defining Event Handlers.

Module IV: 9 Hours

XML: Introduction to XML, Defining XML tags, their attributes and values, Document Type Definition, XML Schemes, Document Object Model, XHTML Parsing XML Data – DOM and SAX Parsers in java.

Introduction to JSP: The Anatomy of a JSP Page, JSP Processing, Declarations, Directives, Expressions, Code Snippets, implicit objects.

Server Side Programming: Common Gateway Interface (CGI), Active Server Pages.

Internet applications: E-commerce and security issues including symmetric and asymmetric key, encryption and digital signature, and authentication, firewall.

Text Book:

1. HTML,The Complete Reference by Thomas Powell, 5th Edition, Tata McGrawHill,2010.
2. JavaScript the Complete Reference, Thomas Powell, Fritz Schneider, 3rd Edition, Tata McGrawHill,2012 .

Reference Book:

1. The Complete Reference PHP, 1st Edition, Steven Holzner, Tata McGraw Hill, 2007
2. An Introduction to XML and Web Technologies,Abders Moller and Michael Schwartzbach, 1st Edition, Addison Wesley, 2009.

MSCS203 SOFTWARE ENGINEERING AND OOAD (3-0-0)

Module I: 8 Hours

Introduction to Software Engineering: Evolution and Emergence of Software Engineering; Software Life Cycle Models: Classical Waterfall Model, Iterative Waterfall Model, V-Model, Prototyping Model, Incremental Development Model, Evolutionary Model, RAD model, Agile development models & Spiral model.

Module II: 12 Hours

Software Project Management: Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques, COCOMO model, Halstead's Software Science, Scheduling, Staffing, Risk Management; Requirements Analysis & Specification: Requirements Gathering and Analysis, SRS, Formal System Specification.

Software Design: Overview of the Design Process, Cohesion and Coupling, Layered Arrangement of Modules, Approaches to Software Design; FOD: SA/SD Methodology, DFD, Structured Design and Detailed Design.

Module III: 8 Hours

Object Modelling Using UML: Object-Orientation Concepts, Unified Modelling Language (UML); UML Models: Use Case Model, Class Diagram, Interaction Diagrams, Activity Diagram, State Chart Diagram, Package, Component and Deployment Diagrams; Object-Oriented Software Development: OOAD Methodology.

Module IV: 8 Hours

Coding & Code Review; Testing: Basic Concepts, Black-box and White-box Testing, Debugging, Unit Testing and System Testing, Testing Object-Oriented Programs, Software Reliability, Software Quality, QMS, SEI CMM, Six Sigma; CASE, Software Maintenance, Emerging Trends.

Text Books:

1. R. Mall, Fundamentals of Software Engineering,5th Edition, PHI Learning, 2021.
2. R. S. Pressman, Software Engineering - A Practitioner's Approach,8th Edition, McGraw Hill Education, 2022.

Reference Books:

1. I. Somerville, Software Engineering, 10th Edition, Pearson Education, 2023.
2. C. Larman, Applying UML and Patterns,3rd Edition, Pearson Education, 2016.

MSCS204 COMPUTER NETWORK (3-0-0)

Module I: 8 Hours

Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization:

Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Module II: 10 Hours

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

Module III: 8 Hours

Network Layer: Switching, Logical addressing – IPV4, IPV6; Error reporting and Management protocols: ICMP, IGMP. Address mapping – ARP, RARP, Bootstrap protocol and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Module IV: 10 Hours

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

Application Layer: Domain Name Space (DNS), DDNS, EMAIL, File Transfer Protocol (FTP), HTTP, SNMP. Firewalls and Introduction to Cryptography

Text Books:

1. B. A. Forouzan, Data Communication and Networking, 6th Edition,Tata McGraw–Hill, 2022.
2. Andrew S Tanenbaum, “Computer Networks”, 6thEdition, Pearson Education, 2022.

Reference Books:

1. J. F. Kurose and K. W. Ross, Computer Networking - A Top-Down Approach Featuring the Internet, 8th Edition, Pearson Education, 2022.
2. L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach, 6th Edition, Morgan Kaufmann Publishers, 2022.

MSCS205 DATA WAREHOUSING AND MINING (3-0-0)

Module I: 9 Hours

Introduction to Data Warehousing and Data Mining: Data Warehouse Defined, Features of a Data Warehouse, Data Granularity, The Information Flow Mechanism, Metadata, Two Classes of Data, The Lifecycle of Data, Data Flow from Warehouse to Operational Systems, Failures of Past Decision-Support Systems, Operational Versus Decision-Support Systems, Data Warehouse v/s Data Mining, Data Mining Process, Data Mining Functionalities, Data Pre-processing – Descriptive Data Summarization, Data Cleaning, Integration and Transformation, Reduction

Module II: 9 Hours

The Building Blocks of a Data Warehouse and Data Warehouse Schema: Data Warehouse Architecture Goals, Data Warehouse Architecture, Data Warehouse and Data Mart, Issues in Building Data Marts, Building Data Marts, Other Data Mart Issues, Overview of the Components, Data Warehouse Schema: The Star Schema, The Snowflake Schema, Aggregate Tables, Fact Constellation Schema or Families of Star, Keys in the Data Warehouse Schema

Module III: 9 Hours

Data Warehouse Modelling and Online Analytical Processing: Building the Fact Tables and Dimension Tables, Characteristics of a Dimension Table, Characteristics of a Fact Table, The Factless Fact Table, Updates To Dimension Tables, Cyclicity of Data - Wrinkle of Time, Dimensional Modeling, Strengths of Dimensional Modeling,Data Warehouse and the Data Model, Enhancing the Data Warehouse Performance Data Warehouse Design,

Usage and Implementation: Data Warehouse Design Process, Data Warehouse Usage for Information Processing

Module IV: 9 Hours

Efficient Data Cube Computation, Data Cube and OLAP, Typical OLAP Operations, From Online Analytical Processing to Multidimensional Data Mining,

Data Mining Techniques:A Statistical Perspective on Data Mining, Classification, Issues in Classification, Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms, Prediction – Prediction techniques, Linear and Non-Linear Regression. Clustering: Applications of clustering, Categorization of Major Clustering Methods: Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Outlier Detection.

Text Books:

1. Jiawei Han and MichelineKamber, “Data Mining Concepts & Techniques”, 3rd Edition,Elsevier Pub, 2021.
2. M. H. Dunham. Data Mining, “Introductory and Advanced Topics”, 1st Edition,Pearson Education Publisher, 2006

Reference Books:

1. ReemaThareja, “Data Warehousing”,2nd Edition, Oxford University Press, 2009.
2. PaulrajPonniah, “Data Warehousing Fundamentals”, 2nd Edition, John Wiley & Sons, Inc, 2010.

MSCS206 WIRELESS SENSOR NETWORK(3-0-0)

Module I: 8 Hours

Introduction: Overview of WSN & its technology, motivation & applications, Taxonomy of WSN technologies, Traditional layered stack, Cross-layer designs, Sensor network architecture.

Sensor Node Technology: Overview, Hardware & software, Sensor taxonomy, Wireless network trends, Wireless transmission technology & systems, Radio technology primer, Available wireless technologies

Module II: 12 Hours

Medium access control protocols for WSN, Fundamentals of MAC protocols, MAC protocols for WSNs, Sensor-MAC case study, IEEE 802.15.4 LR-WPANs Standard case study, MAC protocols analysis using Markov Chain.

Routing Protocols: Data dissemination & gathering, Routing challenges, design issues, and strategies; Transport Control Protocols: Design issues, Resource aware routing, Data-centric routing, Geographic routing, and Opportunistic routing.

Module III: 8 Hours

WSN Middleware: Principles, Architecture, Existing middleware, Network management - requirements, traditional models, design issues; Security issues of WSN: Possible attacks, Countermeasures, Static & dynamic key distribution.

Module IV: 8 Hours

WSN Platforms & Tools: Sensor node Hardware, Berkeley Motes, Programming challenges, Node-level software platforms, Node-level simulators, State-centric programming; Applications of WSNs: Ultra wide band radio communication, Wireless fidelity systems

Text Books:

1. W. Dargie and C. Poellabauer, Fundamentals of Wireless Sensor Networks - Theory and Practice, Wiley,2010.
2. K. Sohraby, D. Minoli, and T. Znati, Wireless Sensor Networks - Technology, Protocols, and Applications, 1st Edition, Wiley InterScience, 2007.

Reference Books:

1. T. Hara, V. I. Zadorozhny, and E. Buchmann, Wireless Sensor Network - Technologies for the Information Explosion Era, Springer, 2012.
2. B. Krishnamachari, Networking Wireless Sensors, Cambridge University Press, 2005.

MSCS207 MOBILE COMPUTING (3-0-0)

Module – I: 08 Hours

Introduction, Mobile Communications, Mobile Computing Paradigm. Promises/Novel Applications and impediments and Architecture; GSM Services. System Architecture. Protocols. Localization, Calling, Handover, Security, New Data Services, GPRS

Module – II: 10 Hours Wireless

Medium Access Control: Motivation for a specialized MAC [Hidden and exposed terminals. Near and far terminals], SOMA, FDMA TOMA, COMA, Wireless LAN/[IEEE 802.11], Mobile Network Layer IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration. Tunnelling and Encapsulation, Route Optimization, DHCR.

Module – III: 08 Hours Mobile Transport

Layer: Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks.

Module – IV: 10 Hours

Data Dissemination and Synchronization: Communications Asymmetry. Classification of Data Delivery Mechanisms. Data Dissemination, Broadcast Models. Selective Tuning and Indexing Methods.

Mobile Ad hoc Networks: Introduction, Applications a Challenges of a MANET Routing, Classification of Routing Algorithms. Algorithms such as DSR. AODV. DSDV

Text Books:

1. Mobile Communications, Jochen Schiller, 2nd Edition Reprint, Pearson Education, 2016.
2. Mobile Computing, Brijesh K Gupta, 2nd Edition, Khanna Publishers, 2020

Reference Books:

1. Wireless Communications: Principles and Practices, Theodore S. Rappaport, 2nd Edition, Pearson Education, 2022.
2. Mobile Computing , Raj Kamal , 3rd Edition, Oxford University Press, 2018

HSCS208 ENVIRONMENTAL SCIENCE (1-0-0)

Module I:
Multidisciplinary Nature of Environmental Studies; Components of Environment Ecology and Ecosystems: Meaning, Types, Energy Flow Nutrient Flow:
Natural Resources: Renewable and Non-renewable Resources, Environmental Impacts.
Module II:
Biodiversity: Introduction, Types, Effects of Loss of Bio-Diversity. Extinction of Species: Consequences, National efforts towards Biodiversity: Conservation.
Module III:
Pollution: Types, Control Measures, Waste Management.
Disaster Management: Objectives, Types, Preparedness, Mitigation Prevention, Response.
Climate change: Manmade Causes, Green House Effect, Global Warming and its impact, Ozone Layer Depletion and its consequences. Control Measures.
Module IV:
Environment and Development: Social issues, Environmental Ethics, Population Growth and its impact on Environment .Human Rights. Resettlement and Rehabilitation.
Sustainable Development Fundamentals, Sustainable Development in India.
Environmental Protection: Introduction, Government Efforts, Environmental Organizations, Public Awareness, Environmental Education and Training, Green Building, Clean Development Mechanism, carbon Credits.
Environmental Management and Planning: National Green Tribunal, Environmental Impact Assessment: Introduction, EIA Process, Stake holders in EIA Process, EIA 2006. Role of IT in Environment Management and Planning.

Text Books:
1. Environmental Studies (Concept, Impacts, Mitigation and management) by M.P.Poonia and S.C. Sharama, 3rd Edition, Khana Book Publishing Co. (P) T Ltd., 2021.
2. Environmental Engineering G.kiely,TMH, 2006.
Reference Books:
1. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela, 3rd Edition, PHI Learning, 2008
2. Environmental Science by Daniel B. Botkin& Edward A. Keller, Wiley INDIA edition, 2009.

MSCS250 INTERNET AND WEB TECHNOLOGY LAB (0-0-3)

1. Create a HTML page, which has properly aligned paragraphs with image along with it.
2. Write a program to display list of items in different styles.
3. Create both client side and server side image maps.
4. Create your own style sheets and use them in your web page.
5. Create a form with various fields and appropriate front and validations using any one of the scripting languages.
6. Develop a JavaScript program to get Register Number as Input and print the Student's total mark and grades.
7. Create a web page using XML.
8. Write a program to connect a XML web page to any database engine.
9. Write a PHP program to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page upon reopening of the same page.
10. Write a PHP program to store page views count in SESSION, to increment the count on each refresh, and to show the count on web page.

MSCS251 SOFTWARE ENGINEERING LAB (0-0-3)

LIST OF EXPERIMENT

1. To perform requirement analysis and generate Software Requirement Specification (SRS) document for suggested system.
2. To develop the function-oriented diagram: Data Flow Diagram (DFD) and Structured chart of given problem statement.
3. To draw the ER- diagram for given application software.
4. To perform the user's view analysis for the suggested system: Use case diagram.
5. To draw the structural view diagram for the system: Class diagram, object diagram.
6. To draw the behavioural view diagram: State-chart diagram, Activity diagram
7. To draw the behavioural view diagram for the suggested system: Sequence diagram, Collaboration diagram
8. To draw the implementation view diagram: Component diagram for the system.
9. To perform various testing operations using the testing tool unit testing, system testing for a suggested system.
10. Draw PERT Chart and GANT chart for selected software project.

List of projects on different problem statement

a. Student Result Management System
b. Library management system
c. Inventory control system
d. Accounting system
e. Fast food billing system
f. Bank loan system
g. Blood bank system
h. Railway reservation system
i. Automatic teller machine
j. Video library management system
k. Hotel management system
l. Online Student Registration System
m. E-ticking n. Share online trading
n. Online Examination System
o. Resource management system
p. Court case management system

MSCS252 COMPUTER NETWORK LAB (0-0-3)

1. Error detection in a packet using Checksum
   For error detection by checksums, data is divided into fixed sized frames or segments.
   Sender's End − The sender adds the segments using 1's complement arithmetic to get the sum. It then complements the sum to get the checksum and sends it along with the data frames.
   Receiver's End − The receiver adds the incoming segments along with the checksum using 1's complement arithmetic to get the sum and then complements it.
   If the result is zero, the received frames are accepted; otherwise they are discarded.
2. Simplex stop-and-wait protocol with positive acknowledgement and retransmission
3. Error detection using CRC-CCITT (16-bits)
   In the CRC method, a certain number of check bits, often called a checksum, are appended to the message being transmitted. The receiver can determine whether or not the check bits agree with the data, to ascertain with a certain degree of probability whether or not an error occurred in transmission.
   If an error occurred, the receiver sends a "negative acknowledgement" (NAK) back to the sender, requesting that the message be retransmitted. The technique is also sometimes applied to data storage devices, such as a disk drive. In this situation each block on the disk would have check bits, and the hardware might automatically initiate a reread of the block when an error is detected, or it might report the error to software. The material that follows speaks in terms of a "sender" and a "receiver" of a "message," but it should be understood that it applies to storage writing and reading as well.
4. Token-Bus medium access scheme
5. Selective repeat sliding window protocol
   Selective Repeat protocol provides for sending multiple frames depending upon the availability of frames in the sending window, even if it does not receive acknowledgement for any frame in the interim. The maximum number of frames that can be sent depends upon the size of the sending window.
   The receiver records the sequence number of the earliest incorrect or un-received frame. It then fills the receiving window with the subsequent frames that it has received. It sends the sequence number of the missing frame along with every acknowledgement frame.
   The sender continues to send frames that are in its sending window. Once, it has sent all the frames in the window, it retransmits the frame whose sequence number is given by the acknowledgements. It then continues sending the other frames.
6. Congestion control using leaky bucket algorithm.
7. Find all pair shortest path between vertices using bellman-ford algorithm
8. Client/Server message passing, where a client1 send a character to a server, which on receiving the character increment it to the next letter in the alphabet, and sends the character to client2. The client2 on receiving the value from server, print it and all process terminates.
9. Client/Server message passing, where a client1 send a message that is structure containing values of type character, integer and float to the server. The server should print the message using the format "char value %c integer value %d float value %f" before passing it to the next client. The server should change the value of each element of the structure before passing it to client2. The client2 should print the structure values it receives from the server using the above format.
10. Implement Caesar Cipher algorithm to encrypt and decrypt messages communicated between client and server.

3rd Semester

Third Semester					
Theory					
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	PC	MSCS301	Compiler Design	3-0-0	3
2	PC	MSCS302	Artificial Intelligence and Machine Learning	3-0-0	3
3	PC	MSCS303	Cloud Computing	3-0-0	3
4	PC	MSCS304	Information Security	3-0-0	3
5	PE	MSCS305 MSCS306 MSCS307	Big Data Analytics Internet of Things Embedded Systems	3-0-0	3
Total Credit (Theory)					**15**
Practical					
1	PC	MSCS350	Information Security Lab.	0-0-3	2
2	PC	MSCS351	AI & ML Lab.	0-0-3	2
3	PC	MSCS352	Cloud Computing Lab.	0-0-3	2
4		MSCS353	Seminar and Technical Writing	0-0-2	1
Total Credit (Practical)					**7**
Total Semester Credit					**22**

MSCS301 COMPILER DESIGN (3-0-0)

Module I (9Hrs)
Introduction to Automata Theory: Alphabet, Language, DFA, NFA, NFA-Є, Equivalence of DFA and NFA, Minimisation of DFA, Regular Language, Regular Expression, Conversion of Regular Expression to FA.
Module II (9Hrs)
Compiler Structure: Model of compilation, various phases of a compiler. Lexical analysis: Interface with input parser and symbol table, token, lexeme and patterns, difficulties in lexical analysis, input buffering. Specification of tokens.
Syntax Analysis: Grammar, Parsing, ambiguity, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing LL(1) grammar, Bottom up parsing, operator precedence grammars, LR parsers (SLR, CLR, LALR).
Module III(9Hrs)
Syntax directed definitions: Inherited and synthesized attributes, dependency graph, evaluation order, L- and S-attributed definitions. Type checking: type system, type expressions, structural and name equivalence of types, type conversion.
Run time system: storage organization, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation.
Symbol table management: Data structure for symbol table organization. Error Handling and recovery.
Module IV (9Hrs)
Intermediate code generation: intermediate code representation techniques. Intermediate Code generation for control flow, function call, Boolean expressions and procedure calls.
Code optimization: source of optimizations, optimization of basic blocks, loops, code improving transformations.
Code generation and instruction selection: Issues, basic blocks and flow graphs, register allocation, code generation, DAG representation of programs, peep hole optimization.

Text Books:
1. Alfred V. Aho, Ravi Sethi, and Ullman, “Compilers Priciples, Techniques and Tools”,2nd Edition, 2012, Pearson Publication
2. K. C. Louden, “Compiler Construction, Principle and Practice”,1st Edition, 1997,Cengage Publication

Reference Books:
1. V.Raghvan, “Principles of Compiler Design”,1st Edition, 2017, TMH Publication
2. Levine, Mason and Brown, “Lex& Yacc”,2nd Edition, 1992, O’ Reilly Publication

MSCS302 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (3-0-0)

Module I (9 Hrs.)
Introduction to AI, AI Problems and AI techniques, Solving problems by searching, Problem Formulation. Intelligent Agents: Structure of Intelligent agents, Types of Agents, Agent Environments . Uninformed Search Techniques: DFS, BFS, Informed Search Methods: Heuristic functions, Hill Climbing, Best First Search, A*, Adversarial Search: Game Playing, Min-Max Search, Alpha BetaPruning.
Module II (9 Hrs.)
Knowledge and Reasoning: A Knowledge Based Agent, WUMPUS WORLD Environment, Propositional Logic, First Order Predicate Logic, Forward and Backward Chaining.Expert Systems: Introduction, Design of Expert systems.
Module III (9 Hrs.)
Introduction MLP. Type of Human Learning, Type of Machine Learning:Supervised, unsupervised, reinforcement, General Model of Learning Agents
Module IV (9 Hrs.)
Supervised: holdout method, K-fold cross- validation method, boot strapping, simple-regression method, unsupervised: clustering, association, reinforcement learning model.

Text Books:
1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition,2010, Pearson Education.
2. Elaine Rich, Kevin Knight, Shivshankar B Nair, Artificial Intelligence, McGraw Hill, 3rd Edition.
3. Tom Mitchell, Machine Learning, McGraw Hill , 1997, ISBN 0-07-042807-7
4. Richard O. Duda, Peter E. Hart, David G. Stork, Pattern classification, Wiley , (2nd edition). Wiley, New York, 2001

Reference Books
1. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, 1st Edition, 1996, PHI Learning Pvt. Ltd., New Delhi.
2. Nills J. Nilsson, “Artificial Intelligence: A New Synthesis”, 2nd Edition, 2000, Elsevier India Publications, New Delhi.
3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer , 2011 edition
4. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press , 2016

MSCS303 CLOUD COMPUTING (3-0-0)

Module-I (9 Hrs.)
Basics of Cloud Computing: Introduction, Evolution of Cloud Computing, Cluster Computing, Grid Computing, Mobile Computing, Popular Views, Characteristics of Cloud Computing. Need for Cloud Computing, Types of Cloud Deployment Models, Types of Cloud Service Models, Security Paradigms and Issues of Cloud Computing,

Module-II (9 Hrs.)
Some Popular Cloud Service Providers for PaaS, SaaS, IaaS, NIST Cloud Architecture. Cloud Framework: Introduction, Framework for Cloud Computing Environment, Service Oriented Architecture (SOA), Life Cycle of Services in SOA Integrating SOA and the Cloud, Cloud Framework, Framework Constraints, Workflow and Co-ordination of Multiple Activities, Need of Workflow, Examples of Workflow Tools

Module-III (9Hrs.)
Virtualization: Introduction, Needs of Virtualization in Cloud Computing Environment, Advantages of Virtualization Technique in Cloud Computing Environment, Category of Virtual Machine, Virtualization Model for Cloud Computing, Categorization of Guest OS Virtualization Techniques, Mapping Technique of Virtual Machine to Physical Machine in a
Private Cloud, Draw Backs of Virtualization

Module-V (9Hrs.)
Computing Platforms and Technologies: Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Case Studies: Application Paradigms of Cloud Computing, Security Threats and Protection in Cloud Computing

Text Books:
1. Mastering Cloud Computing by RajkumarBuyya, Christian Vecchiola,S.ThamaraiSelvi, 1st Edition 2013,TMH.
2. George Reese Cloud Application Architectures, First Edition, 2009, O'Reilly Media.

References Books:
1. Cloud Computing and SOA Convergence in Your Enterprise A Step-by-Step Guide by David S. Linthicum,1st Edition, 2009, Pearson.
2. Cloud Computing, Dr. Kumar Saurabh, 2nd Edition, 2012, Wiley India.

MSCS304 INFORMATION SECURITY (3-0-0)

Module-I (9Hrs)
The Security Problem in Computing:The meaning of computer Security, Computer Criminals, Methods of Defense; Elementary Cryptography: Substitution Ciphers, Transpositions, Making "Good" Encryption Algorithms, Private-Key Cryptosystems, The Data Encryption Standard, The AES Encryption Algorithm, Public-Key Cryptosystems, Public Key Encryptions, Uses of Encryption, Pseudo-randomness, and Hashing.

Module-II (9Hrs)
Program Security :Secure Programs, Non-malicious Program Errors, viruses and other malicious code, Targeted Malicious code, controls Against Program Threats, Protection in General-Purpose operating system protected objects and methods of protection memory and address protection, File protection Mechanisms, User Authentication Designing Trusted O.S : Security polices, models of security, trusted O.S. design, Assurance in trusted OS, Implementation examples. Digital Signatures, Authentication, Secret Sharing, Group oriented cryptography, Identification.

Module-III (9Hrs)
Data base & Network Security: Security requirements, Reliability and integrity, Sensitive data, Inference, multilevel database, proposals for multilevel security; Security in Network; Threats in Network, Network Security Controls, Firewalls, Intrusion Detection Systems, Secure E-mail.

Module-IV (9Hrs)
Administering Security: Security Planning, Risk Analysis, Organizational Security policies Physical Security; The Economics of Cyber security; Privacy in Computing; Legal and Ethical Issues in Computer Security: Protecting Programs and data, Information and the law, Rights of Employees and Employers, Software failures, Computer Crime, Case studies of Ethics.

Textbooks:
1. Charles P. Pfleeger& Shari Lawrence Pfleeger, "Security in Computing", Fourth Edition, 2007, Pearson Education, Inc. New Delhi. Pvt. Ltd., New Delhi.
2. WilliamStallings&Lawrie Brown, "Computer Security: Principles and Practice", First Edition, 2008, Pearson Education, New Delhi.

Reference Books
1. Charlie Kaufman, Radia Perlman& Mike Speciner, "Network Security: Private Communication in a Public World", 2ndEdition, 2003, PHI Learning. New Delhi.
2. ChuckEasttom, "Computer Security Fundamentals", First Edition, 2006, Pearson Education, Inc. New Delhi.

MSCS305 BIG DATA ANALYTICS (3-0-0)

MODULE-I (9Hrs.)
Introduction to Big Data: Analytics, Nuances of big data, Value, Issues, Case for Big data, Big data sources, Acquisition, Nuts and Bolts of Big data. Features of Big Data, Security, Compliance, auditing and protection, Evolution of Big data, Best Practices for Big data Analytics, Big data characteristics, Volume, Veracity, Velocity, Variety, Data Appliance and Integration tools.

Module – II (9Hrs.)
Data Analysis : Evolution of analytic scalability, Convergence, parallel processing systems, Cloud computing, grid computing, map reduce, enterprise analytic sand box, analytic data sets, Analytic methods, analytic tools, Cognos, Microstrategy, Pentaho. Analysis approaches, Statistical significance, business approaches, Analytic innovation, Traditional approaches.

Module – III (8 Hrs.)

Stream Computing : Introduction to Streams Concepts, Stream data model and architecture, Stream Computing, Sampling data in a stream, Filtering streams, Counting distinct elements in a stream, Estimating moments, Counting oneness in a window, Decaying window, Real-time Analytics Platform(RTAP) applications, IBM Infosphere, Big data at rest, Infosphere streams, Data stage, Statistical analysis, Intelligent scheduler, Infosphere Streams

Module – IV (10Hrs)
Predictive Analytics and Visualization : Predictive Analytics, Supervised, Unsupervised learning, Neural networks, Kohonen models, Normal, Deviations from normal patterns, Normal behaviours, Expert options ,Variable entry, Mining Frequent itemsets, Market based model, Apriori Algorithm, Handling large data sets in Main memory, Limited Pass algorithm, Counting frequent itemsets in a stream,
Clustering Techniques, Hierarchical, K- Means, Clustering high dimensional data Visualizations, Visual data analysis techniques, interaction techniques; Systems and applications

Text Books:
1. Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS Business Series
2. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Elsevier
Reference Books:
1. AnandRajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press.
2. Jiawei Han, MichelineKamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier

MSCS306 INTERNET OF THINGS (IoT) (3-0-0)

MODULE I (9 Hrs.)
Introduction to Internet of Things Introduction-Definition & Characteristics of IoT , Physical Design of IoT- Things in IoT , IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs , IoT Enabling Technologies- Wireless Sensor Networks , Cloud Computing, Big Data Analytics , Communication Protocols , Embedded Systems, IoT Levels & Deployment Templates.
MODULE II (9 Hrs.)
Domain Specific IoTs Home Automation, Intrusion Detection,Smoke/Gas Detectors, Application of IoT for Smart Cities, Application to Environment , Energy Applications, Retail Applications, Logistics Applications, Agriculture-,Industry Applications of IoT,Health & Lifestyle Applications and M2M Introduction M2M-Difference between IoT and M2M,SDN and NFV for IoT-Software Defined Networking , Network Function Virtualization
MODULE III (9.Hrs)
IoT Platforms Design Methodology-IoT Level Specification, Functional View Specification ,Operational View Specification,Device & Component Integration, Application Development, Motivation for Using Python IoTPhysical Devices &Endpoints,Exemplary Device: Raspberry Pi, Raspberry Pi Interfaces – Serial, SPI , I2C , Programming Raspberry Pi with Python-Controlling LED with Raspberry Pi , Interfacing an LED and Switch with Raspberry Pi ,Interfacing a Light Sensor (LDR) with Raspberry Pi , Other IoT Devices- pc Duino, Beagle Bone Black , Cubieboard
MODULE IV (9 Hrs.)
IoT& Beyond: Use of Big Data and Visualization in IoT, Industry 4.0 Concepts. Overview of RFID,Low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and dataintensiveIoT for continuous recognition applications. Overview of Android / IOS App Development tools & Internet of Everything

Text Books :

1. Rajkamal,"Internet of Things", 2nd Edition, 2022, Tata McGraw Hill publication.
2. Vijay Madisetti and ArshdeepBahga, "Internet of things(A-Hand-on-Approach)" 1st Edition, 2015, Universal Press.

Reference Books :

1. Charless Bell "MySQL for the Internet of things". 1st Edition, 2016, Apress publications.
1. 2. Francis dacosta "Rethinking the Internet of things:A scalable Approach to connecting everything", 1st edition, 2014, Apress publications.

MSCS307 EMBEDED SYSTEMS (3-0-0)

MODULE-I: (9Hrs.)
Introduction to Embedded Systems : Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

MODULE-II: (9Hrs.)
Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

MODULE-III: (9 Hrs)
Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

MODULE-IV: (9 Hrs)
RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.
Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Text Books:
1. Shibu K.V, “Introduction to Embedded Systems”, McGraw Hill Publishing

Reference Books:
1. Raj Kamal, “Embedded Systems”, TMH Publishing
2. Frank Vahid, Tony Givargis, “Embedded System Design”, John Wiley Publishing

MSCS350 INFORMATION SECURITY LAB (0-0-3)

1. Implement Caeser cipher substitution operation.
2. Implement monoalphabetic and polyalphabetic cipher substitution operation.
3. Implement Vigenere Cipher
4. Implement Playfair cipher substitution operation.
5. Implement Hill cipher substitution operation.
6. Implement Rail fence cipher transposition operation.
7. Implement row transposition cipher transposition operation.
8. Implement product cipher transposition operation.
9. Illustrate the Ciphertext only and Known plaintext attacks.
10. Implement a stream cipher technique

MSCS351 AI & ML LAB (0-0-3)

1. Write a Program to Implement Breadth First Search using Python.
2. Write a Program to Implement Depth First Search using Python.
3. Write a Program to Implement Tic-Tac-Toe game using Python.
4. Write a Program to Implement 8-Puzzle problem using Python
5. Write a Program to Implement Water-Jug problem using Python
6. Write a python program to import and export data using Pandas library functions
7. Demonstrate various data pre-processing techniques for a given dataset
8. Implement Simple Linear Regression Models
9. Develop Decision Tree Classification model for a given dataset and use it to classify a new sample.
10. Build KNN Classification model for a given dataset.

MSCS352 CLOUD COMPUTING LAB. (0-0-3)

List of Experiments

1. Install Virtual box/VMware Workstation with different flavours of linux or windows OS on top of windows 10 or 11.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
3. Introduction to linux operating system and commands.
4. Control systems command to clone, commit, push, fetch, pull, checkout, reset, and delete.
5. Install Google App Engine. Create hello world app and other simple web applications using python/java.
6. Use GAE launcher to launch the web applications.
7. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
8. Find a procedure to transfer the files from one virtual machine to another virtual machine.
9. Find a procedure to launch virtual machine using try stack (Online Open stack Demo Version).
10. Install Hadoop single node cluster and run simple applications like word count.

MSCS353 SEMINAR AND TECHNICAL WRITING (0-0-2)

There shall be a seminar in M. Sc (Computer Science) course. For seminar the student shall collect the information on a specialized topic and prepare a technical report, showing his/her understanding on the topic, and submit it to the Department. Further, student has to give a presentation on the seminar report before departmental committee. After successful presentation of seminar each student have to submit a technical report in the department.

The marks for seminar are awarded as follows:

1) Day to day work -	20 Marks
2) Report preparation -	20 Marks
3) Seminar Presentation -	40 Marks
4) Viva-Voce on the Seminar topic -	20 Marks
Total -	100 Marks

4th Semester

Fourth Semester					
Theory					
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**
1	PC	MSCS450	Dissertation Evaluation and Open Defence		12
2	PC	MSCS451	Comprehensive Viva – Voce		4
3			MOOCS -1 (08 – 12 Weeks)*		3
4			MOOCS -2 (08 – 12 Weeks)*		3
Total Credit (Theory)					**16+6***

* The MOOCs courses can be taken by the student in any semester from second semester onwards. However, these two courses must be completed before the final declaration of result.

MSCS450 DISSERTATION EVALUATION AND OPEN DEFENCE

There shall be an M. Sc. dissertation in the 4th semester. The student shall investigate or work on a topic in any subject related to the course. During the dissertation work student shall do experimental or review work or any other type of project approved by the Departmental committee consisting of senior faculty members of different specialization and HOD. The committee should adopt a rational approach in assigning project supervisor to a student in 4th semester with respect to the research interest of the students in different specializations. When a student chooses to do project work in an industries/reputed institutions/universities then the internal faculty member should be the one of the supervisor for completion of the dissertation. Attendance of such students doing project shall be furnished by the internal supervisor based on his interaction with the student. At the end of the 4th Semester the student shall submit a project report and give a power point presentation before the Departmental committee with external Examiner(s) outside the University in the relevant fields.

The award of Marks for the dissertation

1) Day to day work (awarded by the Supervisor) -	100 Marks
2) Dissertation (Awarded by the Committee) -	200 Marks
3) Presentation of dissertation Seminar (Awarded by the Committee) -	100 Marks
4) Viva Voce (Awarded by the Committee) -	100 Marks
Total:	500 Marks

MSCS451 COMPREHENSIVE VIVA – VOCE

There shall be a Comprehensive Viva-Voce at the end of 4th semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and Senior Faculty members of the Department covering different specializations and External Examiners from academic institutes. The Comprehensive Viva-Voce is intended to assess the student's understanding of the subjects he/she studied during the M.Sc. course of study. The Comprehensive Viva-Voce is evaluated for 100 marks by the Committee. There are no internal marks for the Comprehensive Viva-Voice.