COURSES OF STUDIES

M.SC. in COMPUTER SCIENCE

(Effective from the academic session 2023-2025)

Under Choice Based Credit System (CBCS)

VIKRAM DEV UNIVERSITY
JEYPORE - 764001
DIST- KORAPUT, ODISHA

VIKRAM DEV UNIVERSITY
Syllabus for Master of Computer Applications

Programme Outcome:

The Master in Computer Applications is a 2-year curriculum spanning over 4 semesters. The course is designed to equip the students with the ability to develop software systems to solve real-life problems in various domains. The course covers a good mix of both theoretical as well as practical components so that students can gain in-depth understanding of the tools and techniques widely used in the industry, and at the same time develop good analytical, design and implementation skills. At the end of the course, students will have adequate knowledge of mathematics, algorithm development, logical ability, database design techniques, networking concepts, software engineering, object oriented system design, etc. to form a strong base in Computer Science and develop further in other advanced topics such as data mining, soft computing, computer graphics, information security, mobile computing, compiler deign, etc.

Keeping in view the requirements of the evolving software industry and current research trends, courses such as Artificial Intelligence, Big Data Analytics, Internet of Things, Data Science, Blockchain Technology, and Cloud Computing are included as elective papers to provide a good exposure to the students in these state-of-the-art topics. On successful completion of this course, students can make their career in software industries, corporate sectors, Government Organizations as technical professionals, IT consultants or pursue research in advance areas in Computer Science and Applications. Interested students can also do freelancing and establish their start-up companies.

First Semester

Sl. No.	Subject Code	Subject Title	Internal	External	Credits
1.	COMP C101	Mathematical Foundations of Computer Science	20	80	4
2.	COMP C102	Data Structures with C Programming	20	80	4
3.	COMP C103	Computer Architecture	20	80	4
4.	COMP C104	Operating Systems	20	80	4
5.	COMP C105	Management Information Systems	20	80	4
6.	COMP C106P	Lab - 1 (DS & C Programming)	100		4

Second Semester

7.	COMP C201	Data Base Management Systems	20	80	4
8.	COMP C202	Computer Based Optimization Techniques	20	80	4
9.	COMP C203	Design and Analysis of Algorithms	20	80	4
10.	COMP C204	Computer Network	20	80	4
11.	COMP C205	Software Engineering	20	80	4
12.	COMP C206P	Lab - 2 (Data Base Management)	100		4

Third Semester					
13.	COMP C301	Object Oriented Programming and Design with Java	20	80	4
14.	COMP C302	E-Commerce	20	80	4
15.	COMP C303	Data Warehousing and Data Mining	20	80	4
		Elective Courses – I	20	80	4
16.	COMP E311	Soft Computing			
17.	COMP E312	Internet of Things			
18.	COMP E313	Computer Graphics			
19.	COMP E314	Mobile Computing			
20.	COMP C305P	Lab – 3 (Java Programming)	100		4
Choice Based Credit Transfer Course					
21.	COMP CT 300	Computer Fundamentals & C Programming	20	80	4
Fourth Semester					
		Elective Courses – II and III			
22.	COMP E411	Information Security			
23.	COMP E412	Big Data Analytics			
24.	COMP E413	Compiler Design			
25.	COMP E414	Data Science and Python Programming	20	80	4
26.	COMP E415	Machine Learning	20	80	4
27.	COMP E416	Block Chain Technology			
28.	COMP E417	Image Processing			
29.	COMP E418	Cloud Computing			
30.	COMP E419	Service Oriented Computing			
31.	COMP E420	Artificial Intelligence			
32.	COMP PRO	Major Project Work / Dissertation	400		16
Total			**2400**		**96**

Note:

i) A student can opt for ***One*** course from among the courses mentioned under the Elective Course – I in the Third Semester and ***Two*** courses from among the courses mentioned under the Elective Course – II & III in the Forth Semester respectively.

ii) A student can opt for **Non-credit Value Added Course(s)** in the second/third semester.

iii) A student has to undergo the **Add-on Non-credit Course**, "Cultural Heritage of South Odisha" offered by the university in the forth semester.

iv) The course **COMP CT300** is offered by Computer Science department for the students of other PG departments as CBCT Course. Similarly, the students of MCA have to opt for a **CBCT Course** offered by any other department.

First Semester

Sub. Code:COMP C101	**Mathematical Foundations of Computer Science**	
Semester: 1	**Credit: 4**	**Core Course**
Pre-requisites: Basic mathematical concepts		
Course Outcome: ✓ To learn the concepts of set theory and algebraic system ✓ To understand the application of logic in computer science ✓ To know how to represent graphs in computer memory and their applications		

Unit – I 10 hours

Statements and Notations, connectives, statement, formula and truth tables, normal forms, theory of inference for statement calculus, predicate calculus, inference theory of predicate calculus.

Unit – II 10 hours

Functions, recursion, algebraic systems with one binary operations, monoids, semi groups, groups, subgroups, homomorphism, Langrange's theorem, Normal subgroups, residue arithmetic, application of residue arithmetic to security, Group codes.

Unit – III 10 hours

Algebraic systems with two binary operations, Lattice as partial order sets, Boolean, Functions, Finite State Machines.

Unit – IV 10 hours

Basic concepts of Graph Theory, Directed and Undirected Graph, matrix representation of graph, storage representation and manipulation of graph, shortest path and APSP problem, trees and their representation and operations, List and graphs.

Text Books:

1. Discrete mathematical structures with application to computer science, J. P. Tremblay and R. Manohar (Mc Graw Hill International)
2. Elements of Discrete Mathematics- C. L. Liu (Mc Graw Hill)
3. Modern Applied Algebra- G. Birkhoff and T.C. Bartee (Mc Graw Hill)
4. Discrete Mathematics – S K Chakraborty & B K Sarkar, Oxford University Press.

Sub. Code:COMP C102	**Data Structures with C Programming**	
Semester: 1	**Credit: 4**	**Core Course**
Pre-requisites: Algorithm, Basic programming skill		
Course Outcome: ✓ To understand various logical organization of data in computers memory ✓ To develop algorithms for performing different operations on data structures and implement in C language ✓ To learn application of data structures in different areas of computer science		

Unit – I 10hours

Review of C programming, Control structures: conditional and looping statements, Arrays. Multi-dimensional arrays, Structures, Functions, Recursive functions, use of pointers, Dynamic memory allocation using malloc( ) and calloc( )

Unit – II 10hours

Linear data structures and their sequential storage representation, Stack, Queues, Circular Queues and Deques, Operations on these data structures, Applications of Stack and Queue, Priority Queue.
Linear data structures and their linked representation: Singly linked, Circularly linked and doubly linked lists, insertion and deletion operations on these data structures, Representation of sparse matrix using linked list.

Unit – III 10hours

Non-linear data structures: Binary tree representation, Tree traversal: Inorder, Preorder, Postorder (recursive and non-recursive algorithms), Conversion of general tree to Binary tree, Binary search tree, Representations of graph: adjacency matrix, adjacency list, multi list, Graph traversal: Depth first and Breadth first.

Unit – IV 10hours

Performance analysis of Searching techniques such as Sequential and Binary search.
Performance analysis of Sorting techniques such as Insertion, Selection, Bubble, Quick, Radix,Merge, and Heap sort.
Representation of B-tree and AVL tree, creation, insertion and deletion operations on these trees.

Text Books:

1. An Introduction to data structures with applications, J. P. Tremblay and P. G. Sorenson, McGraw Hill.
2. Fundamentals of Data Structures in C - Horowitz, Sahni, Anderson-Freed, Universities Press
3. Data Structures using C - Reema Thareja, Oxford University Press.
4. Data Structure and Algorithms - G. A. V. Pai, McGraw Hills Education India

Sub. Code: COMP C103	**Computer Architecture**	
Semester: 1	**Credit: 4**	**Core Course**
Pre-requisites: Digital Logic		
Course Outcome: ✓ To study design of an elementary basic computer ✓ To have a better understanding of a hardwired and microprogrammed control unit. ✓ To introduce the concept of memory hierarchy ✓ To introduce pipelining andmulti-processor		

Unit – I 10 hours

Register Transfer and Micro-operations:
Register Transfer Language, Register transfer, Bus and memory transfer, Arithmetic, Logical and Shift Micro Operation, Arithmetic Logic Shift Unit

Basic Computer Organization 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 10 hours

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 Complete Instruction, Branch Instructions, Multiple Bus Organization

Micro-Programmed Control:
Control Memory, Address Sequencing: Conditional branching, Mapping of Instruction, Subroutine; Micro Program Example: Computer configuration, Microinstruction format, Symbolic Microinstruction, The fetch routine, Symbolic Microprogram, Binary Microinstruction; Design of Control Unit: Microprogram Sequencer

Unit – III 10 hours

Memory Organization:
Memory Hierarchy, Associative Memory: Hardware Organisation, 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 10 hours

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, Interprocessor arbitration, Interprocessor communication and synchronization, Cache coherence

Text Books:

1. Computer System Architecture- M. M . Mano (PHI)
2. Computes Organization- Carl Hamacher, Zvonko Vranesic, Safwat Zaky 5th Edition, Mc Graw-Hill Education India
3. Computes Organization & Architecture-William Stallings (PHI)

Reference Book:

1. Computer Architecture and Organization- Rajiv Chopra (S. Chand)

Sub. Code: COMP C104	**Operating System**	
Semester: 1	**Credit: 4**	**Core Course**
Pre-requisites: Digital Logic, Computer Organization		
Course Outcome: ✓ To understand the role of operating system as a resource manager ✓ To learn the techniques adopted by an operating system for efficient management of various computing resources ✓ To understand the concept of processes, process synchronization and deadlocks		

Unit – I 10hours

Review of Operating System concepts such as Batch processing, Multiprogramming, Time sharing, Real-time systems, and Multi-tasking, layered structure of OS, OS services.
File systems, File access methods: sequential, indexed and direct, File Allocation Methods, Directory structures, File protection

Unit – II 10hours

Need for CPU Scheduling, Process State Transition diagram, preemptive and non-preemptive scheduling, FCFS, Preemptive and non-preemptive SJF, Priority, Round Robin, multi-level feedback queues, Evaluation of scheduling techniques.
Memory management: Contiguous and non-contiguous allocation, MFT, MVT, memory fragmentation, swapping, paging and segmentation.

Unit – III 10hours

Concept of Virtual Memory, demand paging, page faults, page replacement techniques: FIFO, Optimal, LRU, Belady's Anomaly, frame allocation techniques, Thrashing.
Disk scheduling : FCFS, SSTF, Scan, Look, C-Scan, C-Look

Unit – IV 10hours

Concept of Deadlock, conditions for deadlock, resource allocation graph, deadlock prevention, deadlock avoidance, safety sequence, Banker's algorithm, deadlock detection and recovery,Inter-process Communication (IPC), Concurrent processes, Process synchronization, CriticalSection, Classic IPC Problems, Mutual Exclusion, Semaphore.

Text Books:

1. Operating system concepts, Galvin and Silberschatz, Wiley India.
2. Principles of Operating Systems, Naresh Chauhan, Oxford University Press.

Reference Books:

1. Modern Operating systems, A.S. Tanenbaum, Pearson Education Inc.
2. Operating Systems: A Spiral Approach", Elmasri, Carrick, Levine, McGraw-Hill

Sub. Code:COMP C105	**Management Information Systems**	
Semester: 1	**Credit: 4**	**Core Course**
Pre-requisites: Basic understanding of Computer based systems		
Course Outcome: ✓ To understand business applications from a system point of view ✓ To understand the key functional areas of business applications ✓ To appreciate the use of computers in business for efficiency		

Unit – I 10 hours

Importance of information systems, Framework for business End users, Global information society, Need for information technology in Business, Globalization, Business process re-engineering, Information, System concepts, feedback & controls, Info. System components resources & activities, Types of InformationSystem Operations support systems, management support system.

Unit – II 10 hours

System approach to problem solving, defining problems & opportunities, developing & evaluating alternative solutions, System development cycle: feasibility study, system analysis, system design, prototyping, computer aided systems engineering.

Unit – III 10 hours

Business information systems: marketing information system, manufacturing information system, accounting information system, human resource information system, financial

information system, Transaction Processing system, information system for management, decision support system (DSS & EIS).

Unit – IV 10 hours

Information system for strategic advantage, reengineering business process, Managing information resources & technologies: operational management, resource management, technology management, distributed management, organizational planning & information technology, implementing business changes, security & ethical issues in information systems.

Text Books:

1. Management Information System (4th Edition), James A O'Brien (Galgotia)
2. Management information system, Sadagopan (PHI)

Sub. Code: COMP C106P	**Lab - 1 (DS & C Programming)**	
Semester: 1	**Credit: 4**	**Core Course**
Pre-requisites: Logical thinking and writing of algorithms		
Course Outcome: ✓ To write efficient programs in C and implement various data structures		

The Lab sessions will include design of solution to problems, coding, testing, execution of programs, and interpretation of results. Followings are some of the programming activities:

1. Write programs using various control structures, arrays of different dimensions, Structures, Functions, Recursive functions, Pointer variables, and file concepts in C language.
2. Write programs for dynamic memory allocation using malloc ( ) and calloc ( ) functions.
3. Write programs to insert and delete items in Stack and Queue data structures.
4. Write programs to implement linked lists that allow creation, traversal, insertion, and deletion operations.
5. Write programs for creation and traversal of Binary trees.
6. Write programs to represent graphs in the matrix form and implement graph traversals.
7. Write programs to implement different Searching and Sorting techniques.

Second Semester

Sub. Code: COMP C201	**Data Base Management Systems**	
Semester: 1	**Credit: 4**	**Core Course**
Pre-requisites: Basic understanding of file systems and data structures		
Course Outcome: ✓ To learn the design of database systems ✓ To understand the intricacies of query processing and database transaction management ✓ To learn the design principle and management of distributed database systems		

Unit – I 10 hours

Review of DBMS concepts and architecture, Data modelling using Entity - Relationship (ER) diagrams, Relational model, Relational Algebra and Relational calculus.
Database Design:data dependencies, the normalization process, conversion to 1^{st}, 2^{nd}, 3^{rd}, Boyce-Codd, 4^{th} and 5^{th} normal forms.

Unit – II 10 hours

Query Processing**:** Evaluation of Relational Algebra Expressions, Query Equivalence, Join strategies, Query Execution.
Query optimization, Heuristics in Query Optimization, Semantic Query Optimization, Converting Query Tree to Query Evaluation Plan, multiquery optimization, concept of No SQL

Unit – III 10 hours

Database Transactions, ACID Properties, Serializability, Concurrency control: lock-based and timestamp based protocols
Database recovery techniques: log-based recovery and shadow paging, Database Security. Deadlock detection and recovery.

Unit – IV 10 hours

Distributed database systems: a comparative view of distributed DB and centralized DB, distributed DBMS, levels of distribution transparency, reference architecture, data fragmentation (hierarchical, vertical and mixed), Distributed database design: top-down and bottom up approaches, Management of distributed transactions, concurrency control, distributed deadlocks.

Text Books:

1. Database Systems Concepts, A. Silberschatz, H. F. Korth, S. Sudarshan (McGraw Hill)
2. Distributed Systems: Concepts and Design - George Coulouris, Jean Dollimoreet al Pearson Education, Inc. New Delhi.

Reference Books:

1. Fundamentals of Database Systems, Elmsari and Navathe (Addision Wesley)
2. Database Management Systems – Rajiv Chopra, S Chand pub.

Sub. Code: COMP C202	**Computer Based Optimization Techniques**	
Semester: 2	**Credit: 4**	**Core Course**
Pre-requisites: No pre-requisite required		
Course Outcome: ✓ To study Application of Operation Research ✓ To understand linear programming problem ✓ To understand how to solve real life problems of operation research such as Transportation Problem, Assignment Problem etc ✓ To understand techniques for solving sequencing problem and Project Management		

Unit – I 10 hours

Linear programming problem: Formulation of LPP, Graphical Method, Simplex Method, Artificial variable technique: Two Phase method and Big-M method; Problem of Degeneracy, Special cases: Alternative solutions, Unbounded solutions, Non-existing feasible solutions, Revised simplex method (Emphasis should be only on algorithm)

Unit – II 10 hours

Duality in LPP: Concept of Duality in LPP, General rules for converting any Primal into its Dual, Duality and Simplex Method, Dual simplex method; Integer Programming: Gomory's Cutting Plane Method, Branch and Bound Method

Unit – III 10 hours

Transportation problems: Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Moving towards Optimality, MODI method, Minimization, Degeneracy, Unbalanced transportation problem; Assignment problems: Hungarian method for solution of Assignment problems, Unbalanced Assignment problems, variations in Assignment problems; Travelling salesman problem;

Unit – IV 10 hours

Job Sequencing; Project management: Basic terms, Common errors, Rules forNetwork Construction,Critical Path Method(CPM), Project Evaluation and Review Technique(PERT), Non-linear programming problem (Formulation and Graphical Method), Quadratic programming:Kuhn-Tucker Conditions, Wolfe's Method, Beale's Method

Text Books:

1. Operation Research-S.D. Sharma (Kedar Nath Ramnath Publication)
2. Operations Research – Prem Kumar Gupta and D. S. Hira (S. Chand)
3. Operations Research - Kanti Swarup (Sultan Chand & Sons).

Reference Book:

1. Operation Research – S. R. Yadav & A. K. Malik (Oxford University Press)

Sub. Code: COMP C203	**Design and Analysis of Algorithms**	
Semester: 2	**Credit: 4**	**Core Course**
Pre-requisites: Data Structure		
Course Outcome: ✓ To learn how to analyze algorithms to know their complexity ✓ To have an exposure to different algorithm design techniques ✓ To understand graph algorithms and their applications ✓ To understanding algorithms with exponential time complexity		

Unit – I 10 hours

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

Unit – II 10 hours

Fundamental Algorithmic Strategies: Brute-Force: Linear search, selection sort, Greedy: Huffman coding, Fractional knapsack problem, Activity selection Problem, Dynamic Programming: matrix chain multiplication, Longest common subsequence, Travelling Salesman Problem, Branch- and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving , Knapsack, Travelling Salesman Problem.

Unit – III 10 hours

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

Unit – IV 10 hours

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

Decision, Node cover Decision and Chromatic Number Decision problem) and Reduction techniques.

Text Books:

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

Reference Books:

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

Sub. Code: COMP C204	**Computer Network**	
Semester: 2	**Credit: 4**	**Core Course**
Pre-requisites: Basic understanding of internal components of computer systems and its operations.		
Course Outcome: ✓ To build an understanding of the fundamental concepts of computer networking. ✓ To familiarize the student with the basic taxonomy and terminology of the computer networking area. ✓ To preparing the student for entry Advanced courses in computer networking. ✓ Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.		

Unit – I 10 hours

Introduction to Computer Networks, Uses of Computer Networks, Network Hardware, Network Software, Network Topology, OSI Reference Models, TCP/IP Protocol Suite, Addresses in TCP/IP,Digital and Analog Transmission, Multiplexing Techniques,Switching Techniques,Wireless Transmission, Cellular Radio, Satellite Network, Data Link Layer Design issues, Error Detection and Correction, Elementary Data Link Protocols.

Unit – II 10 hours

Channel Allocation Problem, Multiple Access Protocols, IEEE Standard 802 for LANS and MANS, Internetworking Devices: Repeater, Bridges, Router, Gateway, High-speed LANS, Satellite Networks, Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, TCP/IP Protocol Suit, ATM networks.

Unit – III 10 hours

Transport Layer Services, Elements of Transport Protocols, Performance Issues, Cryptography and Network security.

Unit – IV 10 hours

DNS, Electronic mail, SMTP, FTP, TELNET, SNMP, WWW and HTTP.

Text Books:

1. Computer Networks -A S Tenenbaum (PHI)
2. Data Communications and Networking - B. A. Forouzan (PHI)

Reference Books:

1. Computer Networks – Bhushan Trivedi, Oxford University Press.
2. Computer Networking: A Top-Down Approach Featuring the Internet, 3/e - James F. Kurose & Keith W. Ross (Pearson Education India)
3. Computer Networks: A Systems Approach - Bruce S. Davie and Larry L. Peterson (Elsevier Inc.)

Sub. Code: COMP C205	**Software Engineering**	
Semester: 2	**Credit: 4**	**Core Course**
Pre-requisites: Basic idea of Software development		
Course Outcome: ✓ To have an insight into large-scale software development process ✓ To have an appreciation for the use of an engineering approach to software development ✓ To learn approaches for software cost estimation, building reliable and quality software systems		

Unit – I 10 hours

Evolution of Software Engineering, Software Processes, software Life cycle Models, Software Project Management, Software Requirements, Requirements Engineering, Feasibility study, Requirement analysis and specification, System Models.

Unit – II 10 hours

Software Design, Architectural Design – Cohesion and coupling, Abstraction, Data flow Oriented Design, Object-Oriented Design, User Interface Design.
Rapid Software Development, Software Reuse, Component Based Software Engineering.
Implementation and Testing: Verification and Validation, Software Testing techniques

Unit – III 10 hours

Software Cost Estimation, COCOMO Model, Software Reliability, Software Quality Management, Configuration Management, Software Maintenance.

Unit – IV 10 hours

New trends and technologies in software development, Capability Maturity Model, Capability Maturity Model Integration, Agile software development, Extreme Programming, Service-oriented Software Engineering

Text Books:

1. Fundamentals of Software Engineering - Rajib Mall (PHI)
2. Software Engineering -Ian Sommerville (Pearson Education)
3. Software Engineering: A Practitioner's Approach - Roger Pressman (McGraw Hill)

Sub. Code: COMP C206	**Lab - 2 (Data Base Management)**	
Semester: 2	**Credit: 4**	**Core Course**
Pre-requisites: Database and file concepts		
Course Outcome: ✓ To develop database applications		

- Students are expected to develop the skill of building applications that require storage of large data. The emphasis will be on efficient design of databases to facilitate database access and query processing.
- Students will learn how to create database tables using MySQL and write DML statements to perform database operations like Insertion, Deletion, Updation, etc.
- Students will also write varieties of query expressions including nested and join queries.
- Applications involving Student database, Employee database, Customer database, Bank transactions, etc. will be developed.

Third Semester

Sub. Code: COMP C301	**Object Oriented Programming and Design with Java**	
Semester: 3	**Credit: 4**	**Core Course**
Pre-requisites: Basic Programming and OOPs Concepts		
Course Outcome: ✓ To understand the use of OOPs concepts ✓ To understanding different features and concepts of Java ✓ To be able to write efficient programs in Java		

Unit – I 10 hours

Introduction to Java Programming, Concept of JVM, Data Types and Operations, Structured Programming, Selection Statements, Loops, Methods, Method Abstraction and Stepwise Refinement, Arrays, Classes and Objects, Constructors, Implementing & Designing Classes, Use of Keywords: *static*, *final*, *this*, Class Abstraction and Encapsulation, Strings and Text I/O

Unit – II 10 hours

Inheritance, Use of *super* keyword, Overriding vs Overloading, Abstract Classes and Interfaces, Packages, Polymorphism, Object-Oriented Design and Patterns.

Unit – III 10 hours

GUI Programming: GUI Basics, Graphics, Event-Driven Programming, Creating User Interfaces, Applets and Multimedia, Exception Handling, Binary I/O, Files & Streams, Recursion, Dynamic Binding, Generic Programming.

Unit – IV 10 hours

Multithreading, JDBC, MVC, JavaBeans, Containers, Swing Models, JTable and JTree, Advanced features of Java.

Text Books:

1. Complete Reference – Hebert Schildt
2. Introduction to Java Programming: Comprehensive Version- Y. Daniel Liang, Pearson Education Inc., New Delhi.
3. Programming with Java: A Prime - E. Balagurusamy, McGraw-Hill Education (India).
4. Java How to Program -Harvey M. Deitel & Paul J. Deitel, PHI, New Delhi.

Sub. Code: COMP C302	**E-Commerce**	
Semester: 3	**Credit: 4**	**Core Course**
Pre-requisites: Understanding of commercial systems		
Course Outcome: ✓ To understand different electronic business models ✓ To learn how different electronic payment systems work ✓ To have an insight into the issues and challenges in the implementation of e-commerce		

Unit – I 10 hours

Introduction to e-commerce: Business models and business processes, identifying e-commerce opportunities, international nature of e-commerce, technology infrastructure-internet & WWW; Business strategies for e-commerce: Revenue models in transaction, revenue strategic issues, creating an effective web presence, website usability; Marketing on the web: Web marketing strategies, communicating with different market segments, customer behaviour and relationship intensity, advertising on the web, technology enabled CRM.

Unit – II 10 hours

Business to business strategies: Purchasing, logistics and supply activities, electronic data interchange (EDI), electronic data interchange on the internet, supply chain management using internet technologies, electronic market place & portals (Home shopping, E-marketing, Tele marketing), auctions, online auctions, virtual communicative & web portals.

Unit – III 10 hours

Payment systems in e-commerce: card system, E-cheque, E-cash, E-coin, use of digital signature Technologies for e-commerce: web server hardware & software, e-commerce software Intelligent agents in E-commerce, PUSH & PULL technology

Unit – IV 10 hours

Security issues in e-commerce, online security issues, security for client computers and server computers, communication channel security
Intellectual property in online business, online crime, terrorism & warfare, ethical issues.
Planning for e-commerce: planning e-commerce initiatives, strategies for delivering e-commerce web sites, managing e-commerce Implementations.

Text Books:

1. E-Business and E-Commerce Management- Dave Chaffey (Pearson Education Inc)
2. Electronic Commerce - Gary P. Schneider (CENGAGE Learning India)
3. E-Commerce- K.K. Bajaj, D. Nag (McGraw Hill Education)
4. Electronic Commerce-Technology and Application - Bhaskar Bharat, (McGraw Hill)
5. E-Commerce fundamentals and Applications – Chan (Wiley India)

Sub. Code: COMP C303	**Data Warehousing and Data Mining**	
Semester: 3	**Credit: 4**	**Core Course**
Pre-requisites: Acquire knowledge about methodologies used for analysis of data and various techniques which enhance the data modelling		
Course Outcome: ✓ To identify the scope and essentiality of Data Mining and Warehousing. ✓ Be familiar with mathematical foundations of data mining. ✓ To analyze data, choose relevant models and algorithms for respective applications. ✓ To study spatial and web data mining. ✓ Identify appropriate data mining algorithms to solve real world problems.		

Unit – I 10 hours

Motivation for Data Mining, Introduction to Data Mining, DBMS vs. Data Mining, Issues and Challenges in Data Mining, Application Areas, Knowledge Discovery steps, Concept of Data Warehousing, 3-Tier Architecture, Multidimensional Data Model, OLAP, ROLAP, and MOLAP Operations,

Unit – II 10 hours

Concept Hierarchies, Interestingness Measures, Data Generalization and Summarization-based Characterization, Mining Association Rules, Apriori Algorithm for finding Frequent Item-Sets, Iceberg Queries, Mining Multilevel Association Rules, Mining Distance-Based Association Rules, Correlation Analysis.

Unit – III 10 hours

Classification and Prediction: Decision Tree based Classification, Bayesian Classification, Classification by Back Propagation, K-Nearest Neighbor Classifier
Cluster Analysis: Categorization of Clustering Methods, Partitioning Methods, K-Means and K-Medoids, Hierarchical Methods, Density-Based Clustering (DBSCAN)

Unit – IV 10 hours

Web Mining, Classification of Web Documents, Web Content Mining, Web Structure Mining, Web Usage Mining, Text Mining, Text Clustering, Mining Spatial Databases, Mining Multimedia Databases, Temporal Data Mining, Temporal Association Rules, Sequence Mining.

Text Books:

1. Data mining; Concepts and techniques by J. Han and M. Kamber (Morgan Kaufmann)
2. Data Mining by A.K. Pujari (University press)

Reference Books:

1. Data Mining by Vikram Pudi and P. Radha Krishna (Oxford University Press)
2. Introduction to Data Mining - Tan, Steinbach & Kumar (Pearson)
3. Data Mining: Practical Machine Learning Tools and Techniques - Ian H. Witten & Eibe Frank (Elsevier India)
4. Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management - Gordon S. Linoff & Michael J. A. Berry (Wiley)
5. Data Mining and Analysis Fundamental Concepts and Algorithms - Zaki & Meira (Cambridge University Press)

Sub. Code: COMP E311	**Soft Computing**	
Semester: 3	**Credit: 4**	**Elective Course - I**
Pre-requisites: Basics of algorithms		
Course Outcome: ✓ To understand the basic principles of Soft computing and learn techniques to solve problems that require human intelligence ✓ To have exposure to different application areas of Soft computing ✓ To understand the significance and use of fuzzy systems ✓ To understand the use of genetic algorithms and particle swam optimization		

Unit – I 10 hours

Artificial Neural Network
Fundamental concepts, basic models of Neural Networks, Supervised Learning Network: Perceptron network, Adaline, Madaline, Back-propagation, Radial basis function network, Functional Link Networks

Unit – II 10 hours

Unsupervised Learning Network: Kohenon Self-organization Feature Maps, Learning Vector Quantization, Counterpropagation Networks, Adaptive Resonance Theory Network

Unit – III 10 hours

Fuzzy Logic System
Introduction to Fuzzy Logic, Fuzzy sets, Fuzzy relations, Properties of Fuzzy relations, Fuzzy Compositions, Features of Membership functions, Fuzzification, Lambda cuts for fuzzy sets, Lambda cuts for fuzzy relations, Defuzzification methods, Fuzzy propositions, Formation of Rules, Decomposition of rules, Aggregation of fuzzy rules, fuzzy inference system

Unit – IV 10 hours

Genetic Algorithm
Genetic Algorithm and search space, Genetic Algorithm vs. Traditional Algorithms, Basic Terminologies in Genetic Algorithm, Simple GA, General Genetic Algorithm, Operators in

Genetic Algorithm, stopping condition for Genetic Algorithm flow, Constraints in Genetic Algorithm, Problem solving using Genetic Algorithm, The Schema Theorem

Particle Swarm Optimization
Introduction to Particle Swarm Optimization(PSO), Operation of Particle Swarm Optimization, Basic flow of Particle Swarm Optimization, Comparison between PSO and GA.

Text Books:

1. Principles of Soft Computing - S. N. Sivanadam, S. N. Deepa (Wiley India Pvt. Ltd)
2. Soft Computing and Intelligent Systems Design: Theory, Tools and Applications - Fakhreddine O. Karray, Clarence De Silva (Pearson Education, New Delhi)
3. Genetic Algorithms: Search, Optimization and Machine Learning - D.E. Goldberg (Addison Wesley)
4. Learning and Soft Computing – Vojislav Kecman (Pearson Education)
5. Neural Networks, Fuzzy Logic, & Genetic Algorithms Synthesis & Applications - S. Rajasekaran, and G. A. Vijayalakshmi Pai (PHI)

Sub. Code:COMP E312	**Internet of Things**	
Semester: 3	**Credit: 4**	**Elective Course – I**
Pre-requisites: Computer Network		
Course Outcome: ✓ To learn the concepts behind IoT and different application areas where sensors can be effectively used to capture real-time data for monitoring and control functions. ✓ To understand various protocols that govern the functioning of an IoT System ✓ To understand the security concerns in IoT based systems		

Unit – I 10 hours

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 10 hours

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 10 hours

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 10 hours

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 Books:

1. Internet of Things from Hype To Reality: The Road to Digitization (2nd ed), Ammar Rayes and Samer Salam, Springer, 2019.

Sub. Code:COMP E313	**Computer Graphics**	
Semester: 3	**Credit: 4**	**Elective Course - I**
Pre-requisites:		
Course Outcome: ✓ To learn the core concepts of Computer Graphics ✓ To understand various 2D and 3D transformations ✓ To understand and implement different algorithms of computer graphics		

Unit – I 10 hours

Overview of computer graphics, Video Display Devices: Refresh Cathode-Ray Tubes, Raster scan displays, Random scan displays, Raster scan systems, Random scan systems, Output Primitives: Points and lines, Line drawing algorithms: DDA algorithm, Bresenham's line

algorithm, Circle generation algorithm: DDA Circle Drawing Algorithm, Mid-point Circle Drawing Algorithm, Filled-Area Primitives: Scan line polygon fill algorithm

Unit – II 10 hours

2D Transformation & Viewing:

Basic transformations: Translation, rotation, scaling; Matrix representations & homogeneous coordinates, Composite transformations, Other transformations

The Viewing pipeline, Window to viewport co-ordinate transformation, clipping operations, Point clipping, Line Clipping(Cohen-Sutherland), Polygons Clipping(Sutherland-Hodgeman)

Unit – III 10 hours

3D Transformation & Viewing:

3D transformations: Translation, rotation, scaling & other transformations, Viewing pipeline, Viewing coordinates, Projections, View volume and General Projection Transformations, Clipping

Unit – IV 10 hours

Visible Surface Detection Methods: Classification of Visible-Surface Detection Algorithms, Back-Face Detection, Depth Buffer Algorithm, Scan−Line Method, Depth-Sorting Method, Area Subdivision method

Illumination and Surface-Rendering: Light sources, Basic illumination models: Ambient light, Diffuse reflection, Specular reflection and the Phong model, Combined Diffuse and Specular reflections with multiple light sources, Polygon rendering methods

Text Books:

1. Computer Graphics – Donald Hearn and M. Pauline Baker (Pearson)
2. Computer Graphics - Zhigang Xiang, Roy A. Plastock **(**McGraw-Hill Education, India)

Reference Books:

1. Computer Graphics – Er. Rajiv Chopra, (S. Chand Publication)
2. Principles of Interactive Computer Graphics − W.M. Newmen, R F Sproull (McGraw Hill)

Sub. Code: COMP E314	**Mobile Computing**	
Semester: 3	**Credit: 4**	**Elective Course - I**
Pre-requisites: General understanding of computer networks and communication technologies.		
Course Outcome: ✓ To provide an overview of Wireless Communication networks and its applications in communication engineering.		

- ✓ To explain the various terminologies, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication Networks.
- ✓ To enable students to compare and contrast multiple division techniques, mobile communication systems, and existing wireless networks.

Unit – I 10 hours

Introduction to mobile computing, mobile computing architecture, mobile devices, mobile system networks, data dissemination, mobility management, Security Cellular Network and frequency reuse, Mobile Smartphones, Smart Mobiles and Systems, Handheld Pocket Computers, Handheld Devices, Smart Systems, Limitations of Mobile Devices, Automotive Systems.

Unit – II 10 hours

Modulation, Multiplexing, Controlling the Medium access, Spread spectrum, Frequency Hopping Spread Spectrum, Coding Methods, Code division Multiple Access, IMT-2000 3G Wireless Communication Standards, WCDMA 3G Communication Standards, CDMA2000 3G Communication Standards, I-mode, OFDM, High Speed Packet Access (HSPA) 3G Network, Long Term Evolution, WiMax Rel 1.0 IEEE 802.16e, Broadband Wireless Access, 4G Networks, Mobile Satellite Communication Networks.

Unit – III 10 hours

Data Organization, Database Transactional Models- ACID rules, Query Processing, Data Recovery Process, Database Hoarding Techniques, Data Caching, Client-Server Computing for Mobile Computing and Adaptation, Adaptation software for Mobile Computing, Power-aware Mobile computing, Context-aware Mobile Computing, Mobile Agent, Application Framework, Application Server, Gateways, Service Discovery, Device Management, Mobile File Systems, Security.

Unit – IV 10 hours

Mobile Ad-hoc & sensor networks, MANET and its applications, Routing algorithms: DSR protocol, AODV routing protocol, and TORA. Wireless sensor networks, applications, WLAN architecture, introductory concepts of mobile application languages: XML, J2ME, features of Mobile OS: Palm OS, Symbian OS.

Text Books:

1. Mobile Computing, Raj Kamal (Oxford University press)
2. Mobile Computing Technology, Applications & Service Creation, A K Talukder & R R Yavagal (TMH)

Reference Books:

1. Mobile Communications - Jochen Schiller (Addison-Wesley, Second Edition, 2009)
2. Principles of Mobile Computing - UWE Hansmann, Lother Merk, Martin S. Nicklaus, Thomas Stober (Second Edition, Springer)

Sub. Code: COMP C305P	**Lab – 3 (Java Programming)**	
Semester: 4	**Credit: 4**	**Core Course**
Pre-requisites: Object Oriented concepts		
Course Outcome: ✓ To write efficient java programs using object oriented concepts		

The objective here is to understand the concepts behind object oriented programming. Students will

1. Understand the concept of Java virtual machine and the execution environment of Java
2. Write programs using the concept of Class and Objects.
3. Learn the use of member functions, constructors etc.
4. Implement various forms of inheritance
5. Learn the use of different packages
6. Experiment with different built-in functions available in Java
7. Learn the use of files in Java

Fourth Semester

Sub. Code: COMP E411	**Information Security**	
Semester: 4	**Credit: 4**	**Elective Course**
Pre-requisites: Computer internals working process, computer networking principles and communication techniques.		
Course Outcome: ✓ To understand the common threats faced today ✓ To study the foundational theory behind information security. ✓ To learn the basic principles and techniques when designing a secure system.		

Unit – I 10 hours

Attacks, services and mechanism, security attacks, security services, conventional encryption model, Steganography, cipher principles, data encryption standards, strength of DES, differential and linear crypto analysis, Block cipher design principles, Block cipher model of operation.

Unit – II 10 hours

DES, double DES, Triple DES, international data encryption algorithm, blowfish, RC5, CAST-128, RC2, characterization of advanced symmetric block ciphers, placement of encryption function, traffic confidentiality, key distribution, random number generation, public key cryptography: principles of public key cryptosystem, RSA algorithm, Key management, diffie-Hellman key exchange, Elliptic curve cryptography.

Unit – III 10 hours

Message authentication and Hash function: authentication requirements, functions message authentication codes, hash functions, security of hash functions and MACs, MD5 message digest algorithm, secured hash algorithm, digital signatures, authentication protocols, digital signature standard.

Unit – IV 10 hours

Firewall design principles, IP security architecture, authentication header, encapsulating security payload, security associations, key management.

Text Books:

1. Cryptography and network security Principles and practice - William Stallings (Person education)
2. Applied Cryptography–Schneier (John wiley)

Reference Books:

1. Cryptography and NetworkSecurity, Atul Kahate (TMH)
2. Information Security: The Complete Reference - Bragg Roberta, Mark Rhodes-Ousley & Keith Strassberg (Mc Graw Hill Education)
3. Information Systems Security: Security Management, Metrics, Frameworks and Best Practices - Nina Godbole (Wiley)

Sub. Code: COMP E412	**Big Data Analytics**	
Semester: 4	**Credit: 4**	**Elective Course**
Pre-requisites:		
Course Outcome: ✓ Learn Injecting data into Hadoop ✓ Learn to build and maintain reliable, scalable, distributed systems with Hadooop ✓ Able to apply Hadoop ecosystem components		

Unit – I 10 hours

Introduction to Big data, distributed file system, Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.

Unit – II 10 hours

Introduction to HADOOP Big Data, Apache Hadoop & Hadoop Ecosystem, Moving Data in and out of Hadoop, Understanding inputs and outputs of MapReduce, Data Serialization.

Unit – III 10 hours

Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read, NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce Paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH &Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

Unit – IV 10 hours

HADOOP ecosystem and yarn Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

Text Books:

1. Boris Lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.

2. Chris Eaton, Dirk Deroos et al. "Understanding Big data", McGraw Hill, 2012.
3. Tom White, "HADOOP: The definitive Guide", O Reilly 2012. 4. MapReduce Design Patterns (Building Effective Algorithms & Analytics for Hadoop) by Donald Miner & Adam Shook

Sub. Code: COMP E413	**Compiler Design**	
Semester: 4	**Credit: 4**	**Elective Course**
Pre-requisites: Theory of Computation		
Course Outcome: ✓ To learn the concepts of compiler, different stages of a compiler ✓ To learn techniques for developing a simple language compiler ✓ To understand how a compiler is implemented		

Unit – I 10 hours

Introduction to compliers, Compliers and Interpreters, Phases of Complier: Lexical analysis, syntax analysis, Intermediate code generation, code optimization, object code generation, symbol table management, error handling, multi-pass compliers, cross complier. Lexical analysis: role of lexical analyzer, design of lexical analyzer, finite state machine, transition diagram, regular expression, conversion of NDFSM to DFSM, regular expression to FSM.

Unit – II 10 hours

Syntax Analysis: syntactic specification of programming language, context free grammar, derivation of parser tree, basic parsing techniques, types of parser, shift-reduce parser, operator, grammar, operator precedence grammar, operator precedence parsing, LL(I) grammar, predictive parser.

Unit – III 10 hours

Intermediate code generation: syntax directed translation schemes, implementation of SDTS, intermediate codes: polish notation. Abstract syntax tree, three address codes, quadruples, triples, indirect triples translation of assignment statement, Boolean expression, declarative statement. Symbol table and error handling: data structure of symbol table, types of errors, lexical and semantic errors.

Unit – IV 10 hours

Code optimization: Sources of code optimization, loop optimization, identification of loops, DAG representation, Object code generation: problem of code generation, simple code generation, register allocation and object code generation, peep hole optimization.

Text Books:

1. Principles of Complier Design - Aho & Ullman (Narosa)
2. Complier Design: Theory and practice - Burrett (Mc Graw Hill)

Sub. Code: COMP E414	**Data Science & Python Programming**	
Semester: 4	**Credit: 4**	**Elective Course**
Pre-requisites:		
Course Outcome: ✓ To understand the growing importance of data science ✓ To have an exposure to various tools and techniques used in data science ✓ To implement various data science applications in Python		

Unit – I 10 hours

Introduction to Data Science
Python: basic syntax, interactive shell, editing, saving, and running a script. The concept of data types, variables, assignments, immutable variables, numerical types, arithmetic operators and expressions, comments in the program, understanding error messages, Conditions, Boolean logic, logical operators, ranges, Control statements: if-else, loops (for, while). Break, Continue, Pass, assert, and return statements
Strings and text files, String manipulations: subscript operator, indexing, slicing a string.

Unit – II 10 hours

Lists, tuples, and dictionaries, basic list operators, replacing, inserting, removing an element, searching and sorting lists, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries.
Design with functions: hiding redundancy, complexity, arguments and return values, formal vs actual arguments, named arguments.

Unit – III 10 hours

Arrays in Python: Creating, Indexing and Slicing of Arrays, Numpy Library for Arrays, Pandas Library for Data Processing, Matplotlib Library for Visualization, Seaborn Library for Visualization

Unit – IV 10 hours

Toolboxes for Data scientists, Getting Data, Working with data, Machine Learning, Scikit-learn Library for machine learning, Supervised Learning, Regression Analysis, Recommender Systems, Statistical Natural Language Processing for Sentimental Analysis

Text Books:

1. Core Python Programming, 2nd Edition, by Dr. R. Nageswara Rao. Dreamtech Press.
2. Introduction to Data Science, Laura Igual & Santi Sagui, Springer
3. Data Analytics using Python, by Bharti Motwani, Wiley publication
4. Data science from scratch: first principles with Python. By Joel Grus, First edition. Sebastopol, CA: O'Reilly.

Reference Book:

1. The Fundamentals of Python, by Kenneth A. Lambert, 2011, Cengage Learning.
2. Python for Data Analysis, by Wes McKinney, O'reilly Publication.

Sub. Code: COMP E415	**Machine Learning**	
Semester: 4	**Credit: 4**	**Elective Course**
Pre-requisites: Basics of algorithms and Probability theory		
Course Outcome: ✓ To understand the significance of Machine Learning ✓ To learn mathematical concepts, and algorithms used in machine learning ✓ To have an understanding of supervised, unsupervised and Bayesian learning		

Unit – I 10 hours

Introduction:
What Is Machine Learning? Examples of Machine Learning Applications; Learning Problems, designing a learning system, Issues with machine learning. Concept Learning, Version Spaces and Candidate Eliminations, Inductive bias

Unit – II 10 hours

Supervised and Unsupervised learning:
Decision Tree Representation, Appropriate problems for Decision tree learning, Algorithm, Hypothesis space search in Decision tree learning, inductive bias in Decision tree learning, Issues in Decision tree learning
K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Bases, Functions

Unit – III 10 hours

Artificial Neural networks:
Neural Network Representation, Appropriate problems for Neural Network Learning, Perceptrons, Multilayer Networks and Back Propagation Algorithms, Remarks on Back Propagation Algorithms, Case Study: face Recognition

Unit – IV 10 hours

Bayesian Learning:
Bayes Theorem, Bayes Theorem and Concept Learning, Maximum Likelihood and Least squared Error Hypothesis, MAximim likelihood hypothesis for Predicting probabilities, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier, Bayesian Belief Network, EM Algorithm, Case Study: Learning to classify text

Text Books:

1. Tom M. Mitchell, (2013), Machine Learning, McGraw-Hill Education (Indian Edn.)
2. Ethem Alpaydin, (2013), Introduction to Machine Learning, 2nd Ed., PHI Learning Pvt. Ltd.

Sub. Code:COMP E416	**Block Chain Technology**	
Semester: 4	**Credit: 4**	**Elective Course**
Pre-requisites: Distributed systems and computer security		
Course Outcome: ✓ To understand the security requirements in large-scale computer based transactional systems ✓ To understand the concepts around Blockchain ✓ To have exposure to various applications of Block chain for maintain transparency, traceability and effectiveness		

Unit – I 10 hours

Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public Blockchain.

Unit – II 10 hours

The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis, Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for

BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).

Cryptographic basics for cryptocurrency: a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography.

Unit – III 10 hours

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum -Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Name coin. Bitcoin- Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.

Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts.

Unit – IV 10 hours

Cryptocurrency Regulation: Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Zero Knowledge proofs and protocols in Blockchain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves – Zcash.

Applications of Blockchain: Supply Chain management, Medical Record Management System, IoT

Text Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Gold Feder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
2. R. Pass et al, Analysis of Blockchain protocol in Asynchronous networks, EUROCRYPT 2017. A significant progress and consolidation of several principles).

Sub. Code: COMP E417	**Image Processing**	
Semester: 4	**Credit: 4**	**Elective Course**
Pre-requisites: linear signals and systems, 1-D Fourier Transform, basic linear algebra, basic probability theory and basic programming techniques; knowledge of Digital Signal Processing		
Course Outcome: ✓ To develop a theoretical foundation of fundamental Digital Image Processing concepts. ✓ To provide mathematical foundations for digital manipulation of images; ✓ To learn techniques for image acquisition; preprocessing; segmentation; Fourier domain processing; and compression.		

Unit – I 10 hours

Introduction to digital image processing, Digital image representation, steps in image processing, elements of Digital Image Processing System. Elements of Visual perception, Sampling and Quantization, Basic relationships between Pixels.

Unit – II 10 hours

Image Transforms, Imaging geometry, Photographic film, Fourier transform, properties of two separable Fourier transform, Four Fourier transform, other separable Fourier transforms.

Unit – III 10 hours

Image Enhancement, background of image enhancement, enhancement by point processing, spatial filtering, enhancement in the frequency domain, colour image processing.

Unit – IV 10 hours

Image Restoration: Degradation model, diagonalization of circulant block, circulant matrices, algebraic approach to restoration, inverse filtering, least mean square restoration, interactive restoration, restoration in the spatial domain, geometric transformations.

Text Books:

1. Digital Image Processing - R.C. Gonzalez and R.E. Wood (Addition Wesley)
2. Fundamentals of Digital Image Processing - Anil K. Jain (PHI)

Reference Book:

1. Image Processing, Analysis, and Machine Vision - Milan Sonka , Vaclav Hlavac, Roger Boyle (3rd Edition)

Sub. Code: COMP E418	**Cloud Computing**	
Semester: 4	**Credit: 4**	**Elective Course**
Pre-requisites: Knowledge of operating system and computing models		
Course Outcome: ✓ To have exposure to various cloud models and their implications ✓ To understand the design issues & techniques in the management of cloud resources ✓ To learn about the securities in cloud		

Unit – I 10 hours

Evolution of cloud computing, utility computing, service based computing, characteristics of cloud computing, Cloud service models: IaaS, PaaS, SaaS, Cloud deployment models: public, private, hybrid, community, examples of cloud services such as Amazon EC2, Azure VMs, Google App engine, Salesforce.

Unit – II 10 hours

Virtualization concepts and technologies, scalability and elasticity, deployment, replication and monitoring, identity and access management, Virtual machines provisioning and migration services: VM provisioning process, VM migration services, migration techniques.

Unit – III 10 hours

Cloud Resource provisioning, SLA management in cloud computing, billing, load balancing, admission control, types of SLA, life cycle of SLA, SLA management, automated policy-based management.

Unit – IV 10 hours

Cloud disaster management, privacy and security issues in cloud, digital identity and data security, cloud storage, data centre, Cloud based services and applications in education, healthcare and business.

Text Books:

1. Cloud Computing: Principles and Paradigms – Rajkumar Buyya, James Broberg and Andrzej Goscinski, Wiley publications.
2. Cloud Computing: A Hands-On Approach – A Bahga and V Madisetti, University Press
3. Cloud Computing – U S Pandey and K Choudhary, S Chan

Sub. Code: COMP E419	**Service Oriented Computing**	
Semester: 4	**Credit: 4**	**Elective Course**
Pre-requisites: Knowledge of Internet technology		
Course Outcome: ✓ To understand the present trend of modeling anything as a service and the related architectural designs ✓ To learn the approaches for building service oriented systems and their interoperation ✓ To learn web services languages like WSDL, UDDI & SOAP		

Unit – I 10 hours

Service oriented computing paradigm: computing with services, its suitability for the evolving open environment, a comparative view of objects, components and services, Service-oriented architecture: service provider, service consumer, service registry, SOA collaboration, service orchestration and service choreography.

Unit – II 10 hours

Coordination frameworks for web services: WSCL, Web services choreography interface, WS-coordination: coordination service, activation service, registration service, Service management, Notion of grid services

Unit – III 10 hours

Building SOC applications: elements of SOC design, steps of the SOC approach, service identification, domain decomposition, subsystem analysis, service allocation, component specification, technology realization mapping. Applications of SOC.

Unit – IV 10 hours

Web services architecture, Web services standards, web services technology options: Transport (HTTP, Java Message service), Service Communication protocol (SOAP), Service Description (XML, WSDL), accessing web services, Service registry (UDDI), security issues.

Text Books:

1. Service-Oriented Computing - M.P. Singh & M. N. Huhns (John Wiley & Sons Ltd)
2. Patterns: Service-Oriented Architecture & Web Services, IBM Redbook.

Sub. Code: COMP E420	**Artificial Intelligence**	
Semester: 4	**Credit: 4**	**CoreCourse**
Pre-requisite: Skill of writing algorithms		
Course Outcome: ✓ To understand the basic principles of Artificial Intelligence (AI) and learn techniques to solve problems that require human intelligence ✓ To know various knowledge representation techniques ✓ To have exposure to different application areas of AI such as Natural Language processing, Expert system development ✓ To learn about artificial neural network models and significance of distributed AI		

Unit – I 10 hours

Concepts in AI, defining an AI Problem as state space search, AI problem characteristics, AI techniques, Production systems, control strategies, reasoning - forward & backward chaining. Intelligent Agents: Definitions of a rational agent, reflex, model-based, goal-based, and utility-based agents, the environment in which a particular agent operates.

Unit – II 10 hours

Use of Search Techniques in AI problem solving, Breadth first search, depth first search, iterative deepening.

Heuristic Search Techniques: generate-and-test, Hill climbing, Best first search, A* algorithm problem reduction, AO* algorithm, Minmax & Game trees, Alpha – Beta pruning,

Unit – III 10 hours

Knowledge Representation in AI, issues in knowledge representation, Knowledge Representation using predicate logic, semantic nets, frames, scripts & conceptual Dependency

Expert systems: Architecture, knowledge base, inference engine, Knowledge acquisition, Expert system development, applications of expert systems.
Natural language processing: Syntactic processing, Semantic analysis

Unit – IV 10 hours

Planning in AI, Partial order planning

Uncertainty in AI problem solving: prior probability, conditional probability, Bayes' rule, Dempster-Shafer theory.
Pattern recognition and classification process, learning classification patterns,
Concept of Artificial Neural networks, Distributed AI, Contract-Net Protocol

Text Books:

1. Artificial Intelligence - E. A. Rich and Kelvin Knight (TMH)
2. Artificial Intelligence: A Modern Approach, S. Russell and P. Norvig, Pearson

Reference Books:

1. Introduction to AI and Expert Systems- D.W.Patterson (PHI)
2. Principles of AI and Expert systems development, D. W. Rolston (McGraw Hill)
3. Artificial Intelligence - P. H. Winston (Addison Wesley)

Sub. Code: COMP PRO	**Major Project Work / Dissertation**	
Semester: 4	**Credit: 4**	**Core Course**
Pre-requisites: Knowledge of Programming		

Course Outcome:

- ✓ To develop the ability to analyze the operation of existing systems that require automation
- ✓ To develop the skill to prepare System Requirement Specification documents
- ✓ To design software systems with the use of design tools
- ✓ To write efficient code for implementation
- ✓ To test the system to comply with the requirements
- ✓ To operationalize the end-product

1. Students are expected to undertake a software development project (preferably a real-life project) and implement the same by following a software engineering approach.
2. Students will analyze a system, understand, design, write code, test, and implement the software system as an end-product.
3. Projects can be undertaken in small groups where the students will learn how to work in a software development group.
4. During the project period students will have a feel of working in an IT industry
5. Student has to work under the guidance of a supervisor.
6. S/he has to submit a project report and give a presentation.

Bridge Course
(For *B.Sc./ B.Com./ B.A. Candidates)*

Course Outcome:

- ✓ The purpose of this bridge course is to prepare the non-computer science students with the basic knowledge of computers, its functioning, programming concepts, etc. before getting into the actual MCA curriculum.

UNIT-1

Basic organization of a computer and its working principle, input-output and secondary storage devices, memory representation of data.

UNIT-2

Problem solving with a computer, flowchart, algorithms, basic algorithmic notions, procedure- and object oriented programming
Program development: Problem Analysis, coding, editing, Compiling, executing and testing of programs

UNIT- 3

Types of software, Role of operating system, Business data processing, Concept of DBMS.
Basics of computer networks, network topologies, types of networks, use of different networking components, Internet, WWW, web browsers, search engines, cyber security issues.

UNIT-4

Office Automation tools:
MS WORD: creating a document, editing and formatting, setting header and footer, mail merge
MS EXCELL: creating a spread sheet, use of basic formulae and functions
MS POWER POINT: preparing power point slides, adding animation and different effects.

Books:

1. Computer Fundamentals, P K Sinha, P Sinha, BPB publications.
2. Information Technology, D. V. Singh and S. Kumar, N. Tyagi *et al,* University of Delhi
3. Essential Computer and IT Fundamentals for Engineering and Science Students, N. B. Venketeswarlu, S. Chand publications.

Value Added Courses

COMP VAC - 1

Python Programming

Learning Outcome

Python is a highly interpreted programming language with a simple syntax. It is easy for beginners to learn, it is widely used in data science. This Add-on course is intended for students interested in areas like data science and machine learning.

Course Content

Basic syntax of Python, interactive shell, editing, saving, and running a script. The concept of data types, variables, assignments, immutable variables, numerical types, arithmetic operators and expressions, comments in the program, understanding error messages.

Conditions, Boolean logic, logical operators, ranges, Control statements: if-else, loops (for, while). Break, Continue, Pass, assert, and return statements

Strings and text files, String manipulations: subscript operator, indexing, slicing a string.

Lists, tuples, and dictionaries, basic list operators, replacing, inserting, removing an element, searching and sorting lists, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries.

Design with functions: hiding redundancy, complexity, arguments and return values, formal vs actual arguments, named arguments.

Arrays in Python: Creating, Indexing and Slicing of Arrays, Numpy Library for Arrays, Pandas Library for Data Processing, Matplotlib Library for Visualization, Seaborn Library for Visualization

Books:

1. Core Python Programming, 2nd Edition, by Dr. R. Nageswara Rao. Dreamtech Press.
2. Data science from scratch: first principles with Python. By Joel Grus, First edition. Sebastopol, CA: O'Reilly.
3. Data Analytics using Python, by Bharti Motwani, Wiley publication

COMP VAC – 2

Web Application Development

Learning Outcome:

- ✓ To learn technologies and programming constructs required for developing web applications
- ✓ To learn the art of designing effective and user-friendly web portals

Course Content

Introduction to Web Applications and its programming, Description about Web application, Client, Server (Apache Tomcat/ WebLogic/GlassFish), Client side programming (HTML5/CSS3/JavaScript/JQuery, PHP), Introduction to XML/JSON.

Introduction to JDBC, JDBC Drivers, Architecture of JDBC, Components of JDBC (Classes and Interfaces). Programming with JDBC, creating a database (MS- ACCESS/ORACLE / MySQL), connecting to the database, Loading the Driver, Establishing the Connection, Executing a SQL Query, JDBC Program to retrieve data from database.
Introduction to Result Set, Result Set with Statement Interface, Updating data to the database using Result Set.

Introduction to JSP, Scope of JSP, Anatomy of a JSP program, Execution of a JSP program, Significance of JSP Engine, Built-in objects of JSP, Significance of JSP Elements, Scripting Elements, Scriptlets, Declaration, Expression, Directives and Action Elements, Page Directive, Include Directive, Taglib Directive, Forward action element, Include, Param, useBean with introduction to beans, setProperty, getProperty

Books:

1. Advanced Java Programming, Uttam K. Roy, Oxford University Press
2. Black book, Kogent Learning Solution Inc.
3. Java 2: The Complete Reference by Herbert Schildt, Fifth Edition

CBCS Course offered by the
Department of Computer Science, Vikram Dev University

Sub. Code: COMP CT 300	**Computer Fundamentals & C Programming**	
Semester: 3	**Credit: 4**	**CBCS Course**
Pre-requisites: Basic logical ability and +2 level Mathematics		
Course Outcome: ✓ To have fundamental understanding of computer related concepts ✓ To use computer as tool for problem solving ✓ To learn programming in C		

Unit-1

Key Components of a Computer system and its functioning, Role of operating system, Operating system services, multiprogramming, time sharing, file and directory system.
Problem solving with computers, Problem formulation, design of solution steps, writing algorithms, coding, compiling, executing and testing of programs.

Unit-2

Components of C programming language, data types, constants and variables, statements, operators, Input and Output statements. Control structures: Conditional and Looping statements, IF…ELSE, nested IF…ELSE, SWITCH…CASE, FOR…., WHILE…, DO…WHILE, nested loops.

Unit-3

Use of Arrays in C language: one dimensional and multidimensional arrays, Declaration and operations on arrays, searching of item in an array (sequential and Binary search), sorting of array items using Insertion, Selection and Bubble sort techniques, Matrix operations.

Unit-4

Use of functions in C, Built-in functions, String and mathematical library functions.
User-defined functions: Function declaration, function definition and function call.
Use of structures in C: declaration of structures, structure variables, and array of structures.

Books:

1. Fundamentals of Computers – V Rajaraman & Neeharika Adabala, PHI Pub.
2. Programming in ANSI C, 8/e - E Balagurusamy, TMH publications
3. Let Us C - Yashavant Kanetkar, BPB Publications