

# **BERHAMPUR UNIVERSITY**

## *Syllabus*

for

### **Master of Computer Applications (2-Year Programme)**



**Department of Computer Science  
Berhampur University  
Berhampur-760007 (Orissa)**

**2023**

## BERHAMPUR 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 design, 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	Discrete Mathematical Structures	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	Computer Graphics	20	80	4
15.	COMP C303	Data Warehousing and Data Mining	20	80	4
		<b>Elective Courses – I</b>			
16.	COMP E311	Soft Computing	20	80	4
17.	COMP E312	Internet of Things			
18.	COMP E313	E-Commerce			
19.	COMP E314	Mobile Computing			
20.	COMP E315	Enterprise Resource Planning			
21.	COMP E316	Theory of Computation			
22.	COMP C305P	Lab – 3 (Java Programming)		100	4
<b>Choice Based Credit Transfer Course</b>					
23.	COMP CT 300	Computer Fundamentals & C Programming	20	80	4
<b>Fourth Semester</b>					
		<b>Elective Courses – II and III</b>			
24.	COMP E411	Information Security	20 20	80 80	4 4
25.	COMP E412	Big Data Analytics			
26.	COMP E413	Compiler Design			
27.	COMP E414	Data Science with Python			
28.	COMP E415	Machine Learning			
29.	COMP E416	Block Chain Technology			
30.	COMP E417	Microprocessor			
31.	COMP E418	Cloud Computing			
32.	COMP E419	Service Oriented Computing			
33.	COMP E420	Artificial Intelligence			
34.	COMP PRO	Major Project Work / Dissertation		400	16
<b>Total</b>				<b>2400</b>	<b>96</b>

**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 department.

# First Semester

<b>Sub. Code: COMP C101</b>	<b>Mathematical Foundations of Computer Science</b>	
<b>Semester: 1</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Basic mathematical concepts		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To learn the concepts of set theory and algebraic system</li> <li>✓ To understand the application of logic in computer science</li> <li>✓ To know how to represent graphs in computer memory and their applications</li> </ul>		

## Unit – I

10 hours

Statements and Notations - Connectives - Well-formed Formulas - Truth Tables - Tautology - Equivalence Implication. Logic - Methods of proofs (Equivalence - Converse - Inverse - Contrapositive - and Contradiction - Direct Proofs - Disproving by Counter Example - Proof by Contradiction - Method of Induction). Propositional calculus - Predicative Logic – Existential Quantifiers - Universal Quantifiers - Free & Bound Variables, normal forms, inference theory.

## Unit – II

10 hours

Relations: Relations and their properties, and its applications, representing relations, closure of relations, Warshall's algorithm, equivalence of relations, partial orderings

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

## Unit – III

10 hours

Algebraic Structures-Algebraic Systems-Properties with Examples-Semi Groups-Monoids-Groups and Subgroup, isomorphism, and normal subgroups, rings.

Sequences and Summation, recurrence relations, solving recurrence relations Lattice theory: Lattices and algebras systems, principles of duality, basic properties of algebraic systems defined by lattices, distributive and complemented lattices, and Boolean algebras, 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, Planar Graphs - Isomorphism - Multi-graphs, Euler Circuit and Hamiltonian Cycle.

## Text Books:

1. Discrete Mathematics and its application, K.H. Rosen, Tata McGraw Hill Publication

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

<b>Sub. Code: COMP C102</b>		<b>Data Structures with C Programming</b>	
<b>Semester: 1</b>		<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Algorithm, Basic programming skill			
<b>Course Outcome:</b>			
<ul style="list-style-type: none"> <li>✓ To understand various logical organization of data in computers memory</li> <li>✓ To develop algorithms for performing different operations on data structures and implement in C language</li> <li>✓ To learn application of data structures in different areas of computer science</li> </ul>			

**Unit – I**

10hours

Review of C programming language, Statements and Control structures: conditional and looping statements, Arrays. Multi-dimensional arrays, Structures, array of structures, Functions, call-by value and call-by reference, Recursive functions, use of pointers, Dynamic memory allocation using malloc( ) and calloc( ). Implementation of Sequential and Binary search, Implementation of Insertion, Selection, Bubble, Quick, Radix, Merge, and Heap sort.

**Unit – II**

10hours

Linear data structures and their sequential storage representation, Stack, Queue, Circular Queue and Deque (input-restricted and output-restricted Deque), Insertion and Deletion operations on these data structures, Applications of Stack: Infix to Postfix Conversion, Evaluation of Postfix expression. Evaluation of recursive functions, Tower of Hanoi problem. Applications of Queue: Job queue, message queue, Priority Queue.

**Unit – III**

10hours

Linear data structures and their linked representation: Singly linked, Circularly linked and doubly linked lists, traversal and searching in linked lists, insertion and deletion operations on the linked lists, Applications: Representation of sparse matrix and polynomials.

**Unit – IV**

10hours

Non-linear data structures: Binary tree definition, memory representation, Tree traversal: Inorder, Preorder, Postorder (recursive and non-recursive algorithms), Conversion of general tree to Binary tree, Binary search tree.

B-tree: creation, insertion and deletion operations, AVL tree: creation, insertion and deletion operations.

Graph: Memory representation using adjacency matrix, adjacency list and multi list, Graph traversal: Depth first (both recursive and non-recursive) and Breadth first.

**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

<b>Sub. Code: COMP C103</b>	<b>Computer Architecture</b>	
<b>Semester: 1</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Digital Logic		
<b>Course Outcome:</b>		
✓	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 and multi-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

*Programming the Basic Computer:* Machine Language, Assembly Language  
*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

**Text Books:**

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

**Reference Book:**

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

<b>Sub. Code: COMP C104</b>	<b>Operating System</b>	
<b>Semester: 1</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Digital Logic, Computer Organization		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To understand the role of operating system as a resource manager</li> <li>✓ To learn the techniques adopted by an operating system for efficient management of various computing resources</li> <li>✓ To understand the concept of processes, process synchronization and deadlocks</li> </ul>		

**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, Critical Section, 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

<b>Sub. Code: COMP C105</b>	<b>Management Information Systems</b>	
<b>Semester: 1</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Basic understanding of Computer based systems		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To understand business applications from a system point of view</li> <li>✓ To understand the key functional areas of business applications</li> <li>✓ To appreciate the use of computers in business for efficiency</li> </ul>		

### 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 Information System 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 (4<sup>th</sup> Edition), James A O'Brien (Galgotia)
2. Management information system, Sadagopan (PHI)

<b>Sub. Code: COMP C106P</b>	<b>Lab - 1 (DS &amp; C Programming)</b>	
<b>Semester: 1</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Logical thinking and writing of algorithms		
<b>Course Outcome:</b>		
✓ 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

<b>Sub. Code: COMP C201</b>	<b>Data Base Management Systems</b>	
<b>Semester: 1</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Basic understanding of file systems and data structures		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To learn the design of database systems</li> <li>✓ To understand the intricacies of query processing and database transaction management</li> <li>✓ To learn the design principle and management of distributed database systems</li> </ul>		

### Unit – I

10 hours

DBMS concepts, Data modelling using Entity - Relationship (ER) diagrams, Three-schema architecture of DBMS, schemas, logical and physical data independence, Relational model, Types of keys, Relational Algebra, Relational algebraic operations: SELECT, PROJECT, JOIN and DIVISION, Relational calculus.

### Unit – II

10 hours

Query Processing using SQL, SELECT, INSERT, DELETE, UPDATE Statements in SQL, Query Equivalence, Query optimization, Query Tree, Query Evaluation Plan.

Database Design: Data dependencies: functional, partial, transitive, multi-values, join dependencies, normalization process, 1st, 2nd, 3rd, Boyce-Codd, 4th and 5th normal forms.

### 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: comparison between 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 Dollimore et al  
Pearson Education, Inc. New Delhi.

**Reference Books:**

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

<b>Sub. Code: COMP C202</b>	<b>Computer Based Optimization Techniques</b>	
<b>Semester: 2</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> No pre-requisite required		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To study Application of Operation Research</li> <li>✓ To understand linear programming problem</li> <li>✓ To understand how to solve real life problems of operation research such as Transportation Problem, Assignment Problem etc</li> <li>✓ To understand techniques for solving sequencing problem and Project Management</li> </ul>		

**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 for Network 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)

<b>Sub. Code: COMP C203</b>	<b>Design and Analysis of Algorithms</b>	
<b>Semester: 2</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Data Structure		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To learn how to analyze algorithms to know their complexity</li> <li>✓ To have an exposure to different algorithm design techniques</li> <li>✓ To understand graph algorithms and their applications</li> <li>✓ To understanding algorithms with exponential time complexity</li> </ul>		

**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.

<b>Sub. Code: COMP C204</b>	<b>Computer Network</b>	
<b>Semester: 2</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Basic understanding of internal components of computer systems and its operations.		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To build an understanding of the fundamental concepts of computer networking.</li> <li>✓ To familiarize the student with the basic taxonomy and terminology of the computer networking area.</li> <li>✓ To preparing the student for entry Advanced courses in computer networking.</li> <li>✓ Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.</li> </ul>		

**Unit – I**

10 hours

Data Communications and Networking: Communication Types, Serial and Parallel Data Transmission; Principles of Network Design: Evolution of Computer Networks, Topologies, Network Models (ISO-OSI, TCP/IP), Network Architecture.

Physical Layer: Transmission Medium: Guided Media, Unguided Media, switching: Circuit Switching, Packet Switching, Message Switching.

**Unit – II**

10 hours

Data Link Layer: Framing; Elementary Data Link Protocols: Simplest Protocol, Stop and Wait Protocol; Sliding Window Protocol: Stop and Wait Automatic Repeat Request (ARQ), Go Back N-ARQ, Selective ARQ;

Multiple Access Protocols: Pure ALOHA, Slotted Aloha, CSMA, CSMA/CD, CSMA/CA; Controlled Access Protocol: Reservation, Pooling, Token Passing; Error Detection and Correction, Standard Ethernet, MAC Sublayer

**Unit – III**

10 hours

Network Layer: Network Layer Design issues; Networks-routing algorithms: optimality principle, shortest path, flooding, Distance Vector Routing, Link State Routing, Path Vector Routing, Hierarchical Routing; Congestion control algorithms: Warning bit, Choke packets, Load shedding, Random early discard, Traffic shaping; IP addresses: IPv4, IPv6; Network devices: Repeater, Hubs, Bridges, Switches, Routers, Gateways

**Unit – IV**

10 hours

Transport Layer: Transport Service; Transport Layer Features; Process to Process Delivery: TCP, TCP Connection Establishment-3 Way Handshaking, SYN Flooding Attack, Connection Termination, Flow Control and TCP Sliding Window, Nagel's Rule, TCP Congestion Control, UDP

Application Layer: DNS, Remote Logging, File transfer, Multimedia, Network Security; Internet Security: IPSec, VPN, Firewalls.

**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.)

<b>Sub. Code: COMP C205</b>	<b>Software Engineering</b>	
<b>Semester: 2</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Basic idea of Software development		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To have an insight into large-scale software development process</li> <li>✓ To have an appreciation for the use of an engineering approach to software development</li> <li>✓ To learn approaches for software cost estimation, building reliable and quality software systems</li> </ul>		

**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)

<b>Sub. Code: COMP C206</b>	<b>Lab - 2 (Data Base Management)</b>	
<b>Semester: 2</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Database and file concepts		
<b>Course Outcome:</b> ✓ 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

<b>Sub. Code: COMP C301</b>	<b>Object Oriented Programming and Design with Java</b>	
<b>Semester: 3</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Basic Programming and OOPs Concepts		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To understand the use of OOPs concepts</li> <li>✓ To understanding different features and concepts of Java</li> <li>✓ To be able to write efficient programs in Java</li> </ul>		

### 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.



<b>Sub. Code: COMP C302</b>	<b>Computer Graphics</b>	
<b>Semester: 3</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b>		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To learn the core concepts of Computer Graphics</li> <li>✓ To understand various 2D and 3D transformations</li> <li>✓ To understand and implement different algorithms of computer graphics</li> </ul>		

**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-generating algorithms: DDA Circle Drawing Algorithm, Mid-point Circle 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, Affine 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 Object Representations: Polygon surfaces, Polygon Tables, Plane equations; 3D transformations: Translation, rotation, scaling & other transformations, Composite 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. Newman, R F Sproull (McGraw Hill)

<b>Sub. Code: COMP C303</b>	<b>Data Warehousing and Data Mining</b>	
<b>Semester: 3</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Acquire knowledge about methodologies used for analysis of data and various techniques which enhance the data modelling		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To identify the scope and essentiality of Data Mining and Warehousing.</li> <li>✓ Be familiar with mathematical foundations of data mining.</li> <li>✓ To analyze data, choose relevant models and algorithms for respective applications.</li> <li>✓ To study spatial and web data mining.</li> <li>✓ Identify appropriate data mining algorithms to solve real world problems.</li> </ul>		

### 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)

<b>Sub. Code: COMP E311</b>	<b>Soft Computing</b>	
<b>Semester: 3</b>	<b>Credit: 4</b>	<b>Elective Course - I</b>
<b>Pre-requisites:</b> Basics of algorithms		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To understand the basic principles of Soft computing and learn techniques to solve problems that require human intelligence</li> <li>✓ To have exposure to different application areas of Soft computing</li> <li>✓ To understand the significance and use of fuzzy systems</li> <li>✓ To understand the use of genetic algorithms and particle swarm optimization</li> </ul>		

**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: Fundamental Operating Principle, Adaptive Resonance Theory 1(for binary input vectors)

**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(Alpha-cuts), 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, 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, Advantages and Limitations of Genetic Algorithm

**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)

<b>Sub. Code: COMP E312</b>	<b>Internet of Things</b>	
<b>Semester: 3</b>	<b>Credit: 4</b>	<b>Elective Course – I</b>
<b>Pre-requisites:</b> Computer Network		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ 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.</li> <li>✓ To understand various protocols that govern the functioning of an IoT System</li> <li>✓ To understand the security concerns in IoT based systems</li> </ul>		

**Unit – I**

10 hours

Evolution of IoT, Layered Architecture, Networking Components, Addressing Strategies. IoT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Embedded Systems. IoT Levels and Deployment, IoT Sensing and Actuation: Introduction, Sensors, their characteristics and types. Actuators, their characteristics and types.

**Unit – II**

10 hours

Application Domains of IoT: Home Automation, Smart cities, Industry, Environment, Energy, Logistics, Agriculture, Healthcare, Challenges and Future, Challenges associated with IoT. IoT Processing Topologies: Data Format, processing topologies, IoT device design and selection considerations, Processing offloading.

**Unit – III**

10 hours

IoT Connectivity Technologies: Introduction & types, IEEE 802.15.4, Zigbee, Thread, Wireless HART, RFID, NFC, Z-Wave, LoRa, Wi-Fi, Bluetooth.

IoT Communication Technologies: Introduction, Protocols for Infrastructure, Device Management and Semantic.

**Unit – IV**

Introduction to various IoT Development Platforms, Sensor development boards/platforms, Arduino, Raspberry Pi.

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

**Text Books:**

1. Introduction to IoT by S Mishra, A. Mukherjee, & A. Roy, Cambridge University Press.
2. Internet of Things: A hands-on approach by A. Bahga & V. Madisetti, University Press.

**Reference Books:**

1. The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. D. Hanes, G. Salgueiro, P. Grossetete, R. Barton, J. Henry; IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1st Edition, Pearson India Pvt. Ltd., 2018.
3. Internet of Things from Hype To Reality: The Road to Digitization (2nd ed), Ammar Rayes and Samer Salam, Springer, 2019.

<b>Sub. Code: COMP E313</b>	<b>E-Commerce</b>	
<b>Semester: 3</b>	<b>Credit: 4</b>	<b>Elective Course - I</b>
<b>Pre-requisites: Understanding of commercial systems</b>		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To understand different electronic business models</li> <li>✓ To learn how different electronic payment systems work</li> <li>✓ To have an insight into the issues and challenges in the implementation of e-commerce</li> </ul>		

**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)

<b>Sub. Code: COMP E314</b>	<b>Mobile Computing</b>	
<b>Semester: 3</b>	<b>Credit: 4</b>	<b>Elective Course - I</b>
<b>Pre-requisites:</b> General understanding of computer networks and communication technologies.		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To provide an overview of Wireless Communication networks and its applications in communication engineering.</li> <li>✓ To explain the various terminologies, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication Networks.</li> <li>✓ To enable students to compare and contrast multiple division techniques, mobile communication systems, and existing wireless networks.</li> </ul>		

**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, Lothar Merk, Martin S. Nicklaus, Thomas Stober (Second Edition, Springer)

<b>Sub. Code: COMP E315</b>	<b>Enterprise Resource Planning</b>	
<b>Semester: 3</b>	<b>Credit: 4</b>	<b>Elective Course - I</b>
<b>Pre-requisites:</b> No prerequisite		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To provide an overview of the functional areas of modern enterprises and the challenges</li> <li>✓ To highlight the need for IT enabled systems to achieve efficiency</li> <li>✓ To explain the use of technology in supply chain management</li> </ul>		

**Unit – I**

10 hours

ERP as Integrated Management Information System, Evolution of ERP, Benefits of ERP, Risks of ERP and Competitive Advantages, ERP vs. Traditional Information System. Business Process Reengineering-need and challenges, Management Concerns about BPR, BPR to build Business Model for ERP.

**Unit – II**

10 hours

ERP Packages: Basic Constituent of ERP, Selection Criteria for ERP packages, Procurement Process for ERP Packages, Overview of ERP packages –PEOPLE SOFT, SAP-R/3, BAAN IV, MFG/PRO, IFS/AVALON, ORACLE-FINANCIAL.

**Unit – III**

10 hours

ERP data models, ERP Implementation-issues, Role of Consultants, Vendors, Users, Need for Training, Customization, ERP Implementation Methodology and Post Implementation Issues, ERP Life cycle Operation and Maintenance of an ERP system.

**Unit – IV**

10 hours

Supply Chain Management-Order Management, Logistics, SCM Basic Principles, Task and Competencies, Interfaces and Complexities. Types of SCM, Potential Benefits of SCM, Possible Obstacles, Application System Supporting SCM Engineering. Product Data Management, Sales, Procurement, Production, MRP, Distribution.

**Text Books:**

1. Enterprise Resource Planning Concepts And Practices By Vinod Kumar Garg & N K Venkatakrishna, PHI.
2. Enterprise Resource Planning Alexis Leon Tata McGraw Hill.

**Reference Books:**

1. Enterprise Resource Planning By S Sadagopan, PHI
2. Enterprise Resource Planning, Murthy CSV, HPH
3. A Text Book Of ERP , Jaiswal M., Mcmillan



<b>Sub. Code: COMP E316</b>	<b>Theory of Computation</b>	
<b>Semester: 3</b>	<b>Credit: 4</b>	<b>Elective Course - I</b>
<b>Pre-requisites:</b> Discrete mathematics		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To explain the theoretical foundations of computer science from the formal language perspective.</li> <li>✓ To explain the use of finite state machines for solving computing problems</li> <li>✓ To understand the use of Regular grammars and context free grammar.</li> </ul>		

**UNIT-1:**

Introduction to Finite Automata, FINITE AUTOMATA (FA): Deterministic Finite Automata (DFA)-Formal definition, language of a DFA. Nondeterministic Finite Automata (NFA)-Definition of NFA, Equivalence of NFA and DFA, NFA with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of DFA's.

**UNIT-2:**

REGULAR EXPRESSIONS (RE): Definition, The operators of Regular Expressions, Building RE, Finite Automata and Regular Expressions- Converting DFA's to Regular Expressions, Converting Regular Expressions to Automata, Regular grammars, and FA, Pumping lemma, applications, Closure properties of regular languages. Decision properties of Regular Languages.

**UNIT-3:**

Context Free Grammars and Languages: Context Free Grammars (CFG): Definition, Derivations using a grammar, trees, Leftmost and Rightmost derivations. Ambiguity in grammars and languages: Removing ambiguity from grammars, Inherent ambiguity. Properties of Context-Free Languages: Normal forms for CFGs; Chomsky Normal Form (CNF), Pumping Lemma for Context Free Languages. Decision properties of CFL's.

**UNIT-4:**

Pushdown Automata: Definition, Instantaneous Descriptions of a PDA, language of a PDA, Equivalence of PDA's and CFG's. Introduction to Turing Machine: Notation, Instantaneous Descriptions for Turing machines, Transition Diagrams, Turing machines and Halting. Universal Turing Machines.

**Text Book:**

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman (2007), Introduction to Automata Theory Languages and Computation, 3<sup>rd</sup> edition, Pearson Education, India.

**Reference Books:**

1. Sipser, M. (2012), Introduction to the Theory of Computation, 3<sup>rd</sup> Edition, Cengage Learning
2. John C Martin (2010), Introduction to languages and the Theory of Computation, 4<sup>th</sup> Edition, McGraw-Hill Publishing.

<b>Sub. Code: COMP C305P</b>	<b>Lab – 3 (Java Programming)</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites:</b> Object Oriented concepts		
<b>Course Outcome:</b> ✓ 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

<b>Sub. Code: COMP E411</b>	<b>Information Security</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>Elective Course</b>
<b>Pre-requisites:</b> Computer internals working process, computer networking principles and communication techniques.		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To understand the common threats faced today</li> <li>✓ To study the foundational theory behind information security.</li> <li>✓ To learn the basic principles and techniques when designing a secure system.</li> </ul>		

### 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)

<b>Sub. Code: COMP E412</b>	<b>Big Data Analytics</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>Elective Course</b>
<b>Pre-requisites:</b>		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ Learn Injecting data into Hadoop</li> <li>✓ Learn to build and maintain reliable, scalable, distributed systems with Hadoop</li> <li>✓ Able to apply Hadoop ecosystem components</li> </ul>		

**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

<b>Sub. Code: COMP E413</b>	<b>Compiler Design</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>Elective Course</b>
<b>Pre-requisites:</b> Theory of Computation		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To learn the concepts of compiler, different stages of a compiler</li> <li>✓ To learn techniques for developing a simple language compiler</li> <li>✓ To understand how a compiler is implemented</li> </ul>		

**Unit – I**

10 hours

Introduction to compilers, Compilers and Interpreters, Phases of Compiler: Lexical analysis, syntax analysis, Intermediate code generation, code optimization, object code generation, symbol table management, error handling, multi-pass compilers, cross compiler. 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 Compiler Design - Aho & Ullman (Narosa)
2. Compiler Design: Theory and practice - Burrett (Mc Graw Hill)

<b>Sub. Code: COMP E414</b>	<b>Data Science with Python</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>Elective Course</b>
<b>Pre-requisites:</b>		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To understand the growing importance of data science</li> <li>✓ To have an exposure to various tools and techniques used in data science</li> <li>✓ To implement various data science applications in Python</li> </ul>		

**Unit – I**

10 hours

Introduction to Data Science

Python: basic syntax, data types and variables, operators and expressions, Control statements: if-else, loops (for, while). Break, Continue, Pass, assert, and return statements, 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, String manipulations and file management.

**Unit – II**

10 hours

Functions, Classes and Objects: Creating a class, the self variable, Constructor, Types of variable, Namespaces, types of methods, Inheritance & Polymorphism: Constructors in Inheritance, Overriding Super Class Constructors and Methods, The Super() method, Types of Inheritance, Polymorphism, Operator Overloading, Method Overloading, Method Overriding

**Unit – III**

10 hours

Python Libraries: Numpy, Pandas Library, Scikit-learn, Matplotlib Library for Visualization, Python for Data scientists  
Supervised Learning: Learning curves, Regression Analysis: Simple Linear Regression, Multiple Linear Regression

**Unit – IV**

10 hours

Support Vector Machine, Random Forest, Logistic Regression, Decision Trees and ID3 Algorithm, The Nearest Neighbour Algorithm, The Naive Bayes Model, Unsupervised Learning: Clustering, Recommender System

**Text Books:**

1. Core Python Programming, 2<sup>nd</sup> Edition, by Dr. R. Nageswara Rao. Dreamtech Press.
2. Introduction to Data Science, Laura Igual & Santi Sagui, Springer
3. Kelleher, J. D., Mac Namee, B., D'Arcy, A. (2015). Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies. United Kingdom: MIT Press.

- An Introduction to Statistical Learning with Applications in Python, 1<sup>st</sup> Edition, by Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Jonathan Taylor, Springer

### Reference Book:

- Data Analytics using Python, by Bharti Motwani, Wiley publication.
- Data science from scratch: first principles with Python. By Joel Grus, First edition. Sebastopol, CA: O'Reilly.

<b>Sub. Code: COMP E415</b>	<b>Machine Learning</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>Elective Course</b>
<b>Pre-requisites:</b> Basics of algorithms and Probability theory		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To understand the significance of Machine Learning</li> <li>✓ To learn mathematical concepts, and algorithms used in machine learning</li> <li>✓ To have an understanding of supervised, unsupervised and Bayesian learning</li> </ul>		

### 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, Maximum 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.

<b>Sub. Code: COMP E416</b>	<b>Block Chain Technology</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>Elective Course</b>
<b>Pre-requisites:</b> Distributed systems and computer security		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To understand the security requirements in large-scale computer based transactional systems</li> <li>✓ To understand the concepts around Blockchain</li> <li>✓ To have exposure to various applications of Block chain for maintain transparency, traceability and effectiveness</li> </ul>		

### 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 - Merkle 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).

<b>Sub. Code: COMP E417</b>	<b>Microprocessor</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>Elective Course</b>
<b>Pre-requisites:</b> Digital Electronics		
<b>Course Outcome:</b>		
✓ The Intel 8085 and 8086 Microprocessor and their application		
✓ Interfacing of microprocessor with peripheral devices		
✓ Application of Microprocessor and Microcontroller in industrial application		

**Unit – I**

10 hours

Microprocessor and Microprocessor-Based System: Fundamental of Microprocessor, Organization of Microprocessor-Based System, Architecture of 8085 Microprocessor, Bus Organization of 8085 Microprocessor, Memory Interfacing, Interfacing I/O Devices.

**Unit – II**

10 hours

Programming the 8085: Introduction to 8085 Instruction, Stack and Subroutines, Counter and Time Delay: Hexadecimal Counter, Instruction Execution and Timing Diagram, Assembly Language Programming of 8085.

**Unit – III**

10 hours

Interfacing Peripherals (I/Os): The 8255A Programmable Peripheral Interface, Direct Memory Access (DMA) and 8237 DMA Controller.

**Unit – IV**

10 hours

The 16-bit Microprocessor: Architecture of 8086, Signal Description of 8086, Register Organization of 8086, Physical Memory Organisation, Addressing Modes of 8086, Instruction Set of 8086 and Assembly Language Programming.

**Text Books:**

1. R. S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Prentice Hall
2. K. M. Bhurchandi, A. K. Ray, “Advanced Microprocessors and Peripherals”, 3rd Edition, Tata McGraw Hill

**References:**

1. B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications, 2001
2. Senthil Kumar, N., Saravanan, M., Jeevananthan, S. (2010). Microprocessors and Microcontrollers. India: Oxford University Press.
3. D. Hall, “Microprocessor and Digital Systems”, McGraw-Hill

<b>Sub. Code: COMP E418</b>	<b>Cloud Computing</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>Elective Course</b>
<b>Pre-requisites:</b> Knowledge of operating system and computing models		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To have exposure to various cloud models and their implications</li> <li>✓ To understand the design issues &amp; techniques in the management of cloud resources</li> <li>✓ To learn about the securities in cloud</li> </ul>		

**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 Security - Infrastructure Security - Network level security, Host level security, Application-level security – Data security and Storage - Data privacy and security Issues, Jurisdictional issues raised by Data location - Identity & Access Management - Access Control - Trust, Reputation, Risk - Authentication in cloud computing, Cloud disaster management.

Cloud 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 Madiseti, University Press
3. Cloud Computing – U S Pandey and K Choudhary, S Chan

<b>Sub. Code: COMP E419</b>	<b>Service Oriented Computing</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>Elective Course</b>
<b>Pre-requisites:</b> Knowledge of Internet technology		
<b>Course Outcome:</b>		
✓ 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.

<b>Sub. Code: COMP E420</b>	<b>Artificial Intelligence</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>CoreCourse</b>
<b>Pre-requisite:</b> Skill of writing algorithms		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To understand the basic principles of Artificial Intelligence (AI) and learn techniques to solve problems that require human intelligence</li> <li>✓ To know various knowledge representation techniques</li> <li>✓ To have exposure to different application areas of AI such as Natural Language processing, Expert system development</li> <li>✓ To learn about artificial neural network models and significance of distributed AI</li> </ul>		

**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.

**Unit – II**

10 hours

Uninformed Search: Breadth first search, depth first search, iterative deepening, bidirectional and beam search.

Heuristic Search Techniques: Generate-and-Test, Hill climbing, Best first search, A\* algorithm problem reduction, AO\* algorithm, Min-max & 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.

Reasoning under uncertainty: Bayesian Belief networks, Dempster Shafer theory

Expert systems: Architecture, knowledge base, inference engine, Knowledge acquisition, Expert system development, applications of expert systems.

**Unit – IV**

10 hours

Natural language processing: Syntactic processing, top-down and bottom-up parsing, Semantic analysis,

Planning in AI, Pattern recognition and classification process, learning classification patterns, 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)

<b>Sub. Code: COMP PRO</b>	<b>Major Project Work / Dissertation</b>	
<b>Semester: 4</b>	<b>Credit: 4</b>	<b>Core Course</b>
<b>Pre-requisites: Knowledge of Programming</b>		
<b>Course Outcome:</b> <ul style="list-style-type: none"> <li>✓ To develop the ability to analyze the operation of existing systems that require automation</li> <li>✓ To develop the skill to prepare System Requirement Specification documents</li> <li>✓ To design software systems with the use of design tools</li> <li>✓ To write efficient code for implementation</li> <li>✓ To test the system to comply with the requirements</li> <li>✓ To operationalize the end-product</li> </ul>		

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.

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, Berhampur University**

<b>Sub. Code: COMP CT 300</b>	<b>Computer Fundamentals &amp; C Programming</b>	
<b>Semester: 3</b>	<b>Credit: 4</b>	<b>CBCS Course</b>
<b>Pre-requisites:</b> Basic logical ability and +2 level Mathematics		
<b>Course Outcome:</b>		
<ul style="list-style-type: none"> <li>✓ To have fundamental understanding of computer related concepts</li> <li>✓ To use computer as tool for problem solving</li> <li>✓ To learn programming in C</li> </ul>		

**Unit-1**

Basic structure of a computer and its working, High-level and low-level languages, Types of software: System software, utility software, application software, Operating system, Interpreter, Compiler.

Problem solving with computers, Problem formulation, design of solution steps, writing algorithms, coding, compiling, executing and testing of programs.

**Unit-2**

Computer network, LAN, WAN, MAN, Internet and its services, WWW, URL, web browsers, search engines, teleconferencing.

Computer security, Cyber Threats, Cyber Crime, Cyber terrorism, SPAM, Phishing, Spyware, malware, social engineering attacks, Countermeasures.

**Unit-3**

Introduction to C programming language, data types, constants and variables, statements, operators, Input and Output statements. Control statement: Conditional and Looping statements, IF...ELSE, nested IF...ELSE, SWITCH...CASE, FOR...., WHILE..., DO...WHILE, nested loops.

**Unit-4**

Use of Arrays in C language: one dimensional and multidimensional arrays, Declaration and operations on arrays, Matrix operations.

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
4. Computer Fundamentals – D P Nagpal, S. Chand