REVISED DETAILED STRUCTURE OF

BCA Programme

with effect from Session 2022-23

Bachelor of Computer Applications (BCA)

THREE YEAR COURSE

Centre of Computer Education & Training

Institute of Professional Studies

University of Allahabad

Prayagraj-211002

SEMESTER I								
S.No.	**Course Code**	**Course Title**	**Credit**					
			L	T	P	C	Int.	Ext.
1	BCA101	Mathematics -I	2	1	0	3	40	60
2	BCA102	Statistics	2	1	0	3	40	60
3	BCA103	Digital Electronics	2	1	0	3	40	60
4	BCA104	Fundamentals of Programming with 'C'	2	1	0	3	40	60
5	BCA105	Communication Skills	2	1	0	3	40	60
6	BCA106	Discrete Structures & Graph Theory	2	1	0	3	40	60
7	BCA231	Lab I: Programming in C	0	1	3	4	40	60
	BCA232	Lab II : Digital Electronics	0	1	3	4	40	60
			12	2	12	26		

SEMESTER II								
S.No.	**Course Code**	**Course Title**	**Credit**					
			L	T	P	C	Int.	Ext.
1	BCA107	Mathematics -II	2	1	0	3	40	60
2	BCA108	Database Management System	2	1	0	3	40	60
3	BCA109	Computer Organization & Architecture	2	1	0	3	40	60
4	BCA110	Data Structures	2	1	0	3	40	60
5	BCA111	Software Engineering	2	1	0	3	40	60
6	BCA112	Principles of Management	2	1	0	3	40	60
7	BCA233	Lab I : DBMS	0	1	3	4	40	60
	BCA234	Lab II : Data Structures	0	1	3	4	40	60
			12	2	12	26		

SEMESTER III								
S.No.	**Course Code**	**Course Title**	**Credit**					
			L	T	P	C	Int.	Ext.
1	BCA113	Core Java	2	1	0	3	40	60
2	BCA114	Design & Analysis of Algorithms	2	1	0	3	40	60
3	BCA115	Introduction to System Software	2	1	0	3	40	60
4	BCA116	Principles of Programming Languages	2	1	0	3	40	60

5	BCA117	Fundamentals of Computer Networks	2	1	0	3	40	60
6	BCA118	LINUX & Shell Programming	2	1	0	3	40	60
7	BCA235	Lab I: Core Java	0	1	3	4	40	60
	BCA236	Lab II: LINUX & Shell Programming	0	1	3	4	40	60
			12	2	12	26		

SEMESTER IV

S.No.	Course Code	Course Title	Credit					
			L	T	P	C	Int.	Ext.
1	BCA119	Operating Systems	2	1	0	3	40	60
2	BCA120	Machine Learning Techniques	2	1	0	3	40	60
3	BCA121	Compiler Design	2	1	0	3	40	60
4	BCA122	Introduction to Artificial Intelligence	2	1	0	3	40	60
5	BCA123	OOPS using PYTHON	2	1	0	3	40	60
6	BCA124	Principles of Cryptography and Cyber Security	2	1	0	3	40	60
7	BCA237	Lab I: Machine Learning Lab	0	1	3	4	40	60
	BCA238	Lab II: PYTHON Programming Lab	0	1	3	4	40	60
			12	2	12	26		

SEMESTER V

S.No.	Course Code	Course Title	Credit					
			L	T	P	C	Int.	Ext.
1	BCA125	.Net Framework & C#	2	1	0	3	40	60
2	BCA126	Optimization Techniques	2	1	0	3	40	60
3	BCA127	Computer Graphics	2	1	0	3	40	60
4	BCA128	Fundamentals of Data Science	2	1	0	3	40	60
5	BCA129 (A/B/C)	Elective I	3	1	0	4	40	60
6	BCA239	Lab in C#	0	1	3	4	40	60
	BCA240	Mini Project	0	2	6	8	40	60
			11	3	14	28		

SEMESTER VI

S.No.	Course Code	Course Title	Credit					
			L	T	P	C	Int.	Ext.

1	BCA130	Data Warehousing & Data Mining	3	1	0	4	40	60
2	BCA131 (A/B/C)	Elective II	3	1	0	4	40	60
3	BCA241	Main Project	0	0	20	20	40	60
			6	2	20	28		

Elective I:

S. No.	Course Code	Course Title
1.	BCA129 – A	Digital Image Processing
2.	BCA129 – B	Cyber Ethics
3.	BCA129 – C	Artificial Neural Networks & Deep Learning

Elective II:

S. No.	Course Code	Course Title
1.	BCA131 – A	Computer Vision
2.	BCA131 - B	Parallel Computing
3.	BCA131 – C	Distributed Systems

SEMESTER I

Paper 1: Mathematics-I (BCA101)

Unit 1: Linear Algebra: Basis and Dimension, Linear transformations and their matrix representations, Matrixalgebra, Rank of matrix, Echelon and normal form, Linear systems of algebraic equations, Consistency, Gauss elimination method, Homogeneous and non-homogeneous systems of equations, Inverse of matrices, Determinants, Characteristics polynomial, Eigen values and eigenvectors, Cayley-Hamilton theorem, Eigen values of Hermitian unitary matrices, Solution of linear and non-linear systems.

Unit 2: Differential Calculus: Limit, Continuity & differentiability of functions of one variable, Mean-value Theorems, Rolle's Theorem, Leibnitz formula for nth derivatives of products of functions, Taylor and Maclaurin Theorems, Maxima, Minima and Tangent plane, Tangent lines and normal

Unit 3: Integral Calculus: Theorems of integral calculus, Evaluation of definite & improper integrals, Introduction to Functions of several variables: Partial differentiation, Change of variables in partial differentiation.

Unit 4: Ordinary Differential Equations: Ordinary differential equations of first order, Separable, exact & linear equations, Existence and uniqueness theorems (Statement only)

Unit 5: Ordinary Differential Equations: Higher Order: Higher order linear equations, Wronskians Method of variation of parameters for particular solutions, Euler's and Cauchy's equations, Systems of first order equations with constant coefficients

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig
2. Calculus: Volume I, Aposto
3. Calculus and Analytical Geometry, G.B. Thomas & Finney
4. A Course in Ordinary Differential Equations, Rai, Chaudhary & Friedman
5. Higher Engineering Mathematics, B S Grewal
6. Mathematical Methods, Potter and Goldberg
7. Matrix Theory, David Lewis

Paper 2: Statistics (BCA102)

Unit 1: Elementary Probability: Random Experiments, Sample space, Events, Definitions of probability, Probability of union of events, Conditional Probability, Bayes' theorem, Independence of events.

Unit 2: Random Variables: Random variables, Distribution functions, Probability Mass Function (PMF) of Discrete Random Variables, Probability Density Function (PDF) of continuous random variables, Mathematical expectation, Moments.

Unit 3: Probability Distribution: Discrete uniform distributions, Bernoulli distribution, Poisson distribution, Binomial distribution, Continuous uniform distribution, Normal distribution, Exponential distribution, Reliability function and instantaneous failure rate for exponential distribution.

Unit 4: Statistical Methods: Measures of Central Tendency, Dispersion, Simple linear regression, Method of least squares, Correlation Coefficients, Point and interval estimation, Unbiased, sufficiency, likelihood function and maximum likelihood estimator, Confidence interval for the mean of normal distribution.

Unit 5: Statistical Inferences: Sampling distributions: $\chi 2$, t and F distributions, Basic concept of testing of hypothesis, Role of p-value, Standard tests based on $\chi 2$, t and F distributions

References:

1. Fourier series and Boundary Value Problems, Churchill R.V. (McGraw Hill)
2. Probability and Statistics for Engineers, Irvrin Miller & Friend (Prentice Hall of India)
3. Engineering Statistics, Bowker and Lieberman (Prentice Hall of India)
4. Introductory Statistics and Probability for Engineering Science and Technology, Kirk – Patrick (PHI)
5. Modern Probability Theory and its Applications, Parzen E. (Wiley Eastern)

Paper 3: Digital Electronics (BCA103)

Unit 1: Generation of Computers, Functional block diagram of a computer, Hardware and Software, Generation of programming languages-Machine Level Language, Assembly Level language and High Level Language; Digital Computers ,Number Systems-Binary, Octal, Decimal Hexadecimal, and Conversion; Binary Arithmetic- Binary Addition, Subtraction etc.

Unit 2: Logic Families, Logic Gates, Boolean Algebra, Minterms, Maxterms, Sum of Product Form (POS), Product of Sum Form(SOP), realization of switching expressions by Karnaugh map ; Codes- weighted, unweighted codes, self Complementing Code, Gray Code, BCD, Excess 3 Code ; Code Conversion.

Unit 3: Adder-Half, Full, 4 and 8 bit parallel adder circuits, and Subtractor-Half, full, 4 and 8 bit parallel subtractor circuits; Magnitude comparator, Decoders, Encoders, Multiplexer and demultiplexer, Realization of switching expressions by decoders, encoders, multiplexer and Demultiplexer.

Unit 4: Sequential circuits, latches and Flip Flops-SR, D, JK and T flip flops; Flip Flop Conversion, Analysis of clocked sequential circuits. State reduction and assignment; Counters-Up Counter, Down Counter, Ripple Counter, Ring Counter etc.

Unit 5: Introduction to microprocessors, essential and non-essential elements of a microprocessor, addressing modes, Interrupts and its types, Instruction cycle, machine cycle, T-state, pipelining, IO Methods.

References:

1. William Stalling, “Computer Organization & Architecture”, Pearson education Asia
2. Mano Morris, “Digital Design”, PHI
3. Zaky&Hamacher, “Computer Organization”, McGraw Hill
4. Ram, “Computer Fundamental Architecture & Organization”, New Age

Paper 4: Fundamentals of programming with 'C' (BCA104)

Unit 1: Programming fundamentals and Basics of C Introduction to programming paradigms, Algorithm and flowcharts ,Structure of C program :C programming: Data Types , Storage classes , Constants , Enumeration Constants , Keywords ,Operators: Precedence and Associativity – Expressions ,Input/Output statements, Assignment statements ,Decision making statements ,Switch statement, Looping statements ,Pre-processor directives, Compilation process.

Unit 2: Arrays and strings: Introduction to Arrays: Declaration, Initialization, One dimensional arrays, Example Program: Computing Mean, Median and Mode – Two dimensional arrays, Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) – String operations: length, compare, concatenate, copy ,Selection sort, linear and binary search.

Unit 3: Functions and pointers: Introduction to functions: Function prototype, function definition, function call, Built-in functions (string functions, math functions) ,Recursion ,Example Program: Computation of Sine series, Scientific calculator using built-in functions, Binary Search using recursive functions , Pointers ,Pointer operators ,Pointer arithmetic Arrays and pointers ,Array of pointers :Example Program: Sorting of names , Parameter passing: Pass by value, Pass by reference :Example Program: Swapping of two numbers and changing the value of a variable using pass by reference

Unit 4: Structures: Nested structures, Pointer and Structures, Array of structures, Example Program using structures and pointers, Self referential structures, Dynamic memory allocation, Singly linked list, typedef.

Unit 5: File Processing: Types of file processing: Sequential access, Random access, Sequential access file: Example Program: Finding average of numbers stored in sequential access file, Random access file, Example Program: Transaction processing using random access files, Command line arguments.

References:

1. The C Programming Language, B.W. Kernighan and D.M. Ritchie (PHI)
2. Programming using the C language, R.C. Hutchinson and S.B. Just (McGraw Hill)
3. Outline of Theory and Problems of Programming with C, B.S. Gottfried (Schaum McGraw Hill)
4. C: The Complete Reference, H. Schildt (McGraw Hill)

Paper-5: Communication Skills (BCA105)

Unit 1: Introduction to communication: Importance of Communication, Process of communication, Communication in primitive societies, Types of Communication (Verbal & Non-verbal), One way and two way communication, Principles of communication; Role of news papers, Radio, Cinema and TV.

Unit 2: Business Communication: Flow of communication, Hierarchy structure, Communication Networks (Formal & Informal), Levels of communication – interpersonal, intrapersonal, group, public & mass; Objectives of communication, Barrier to communication and overcoming barriers.

Unit 3: Interactive Skills – Listening skill-Forms of listening, Types of listening; Phonetics, Syllable & syllable stress, Indianism, Group Discussion dynamics, Rate of speech, Vocabulary building, Audio-visual communication.

Unit 4: Business Correspondence & Communication Aids: CV & resume, Application for jobs, Business & official letters, Précis writing, Expansion of an idea, Idioms and phrases, Antonyms and synonyms, change of words into different parts of speech, Report writing.

Unit 5: Professional Skills & Personality Development - Body language, Professional ethics, Self-esteem & Confidence building, Preparing and delivering Power-point presentations, E-mail Writing, Motivation, Team building.

References:

1. Essentials of Business Communication, Rajendra Pal & J S Korlahalli
2. Business Communication, Gyani
3. Effective Communication, Ludlow and Panton
4. A Practical English Grammar, Thomson and Martinet
5. English Conversation Practice, Grant Taylor
6. Developing Communication Skills, Krishna Mohan and Meera Banerji
7. Business Correspondence and Report Writing, R C Sharma and Krishna Mohan
8. Communication Skills, R Datta Roy and K KDhir

Paper-6: Discrete Structures and Graph Theory (BCA106)

Unit 1: Logic: Logical Statement, Logical Operators and their Properties, Tautology, Contradiction and Contingency, Normal Forms and Properties, Implications and Biconditional, Arguments and Fallacy, Rules of Inference, Predicate Logic: Quantifier, Validity of a Predicate, Properties and Translation.

Unit 2: Combinatorics: Permutations and Combination, Summation: Properties of Binomial Function and Generating Functions, Solution of Recurrence Relation.

Unit 3: Set Theory: Relations: Definition of Relation, R-Relative Set, Representation of a Relation, Operations on Relations, Types of Relations, Counting of Relations and Closure of Relations, Equivalence Relations and Partial Order Relation, Properties of Equivalence Relations and Power of a Relation, Functions: Definition of Function, Domain and Range, Types of Functions, Counting of Functions, Inverse of Function, Composition, Group Theory.

Unit 4: Poset, Lattices and Boolean Algebra: Poset, Toset, Woset, Topological Sorting, Hasse Diagram, Extremal Elements of Posets, Lattice, Semi Lattice, Properties of Lattice, Types of Lattice, Boolean Algebra.

Unit 5: Graph Theory: Definition of Graph, Types of Graph, Degree of a Vertex, Special Graph, Graph Representation, Graph Operations, Isomorphism of Graph, Connectivity of Graph, Applications: Euler's Graph, Hamiltonian Graph, Planar Graph, Trees: Spanning Tree, Enumeration of Graph and Graph No.

References:

1. Discrete Mathematical Structures with Application to Computer Science- Tremblay & Manohar
2. Discrete Mathematical Structures – Preparata and Yeh

BCA231: Lab I: Programming in C
BCA232: Lab II: Digital Electronics

SEMESTER II

Paper 1: Mathematics-II (BCA107)

Unit 1: Infinite Series : Convergence and divergence of infinite series, Integral test, Comparison test, Ratio test, Cauchy's root test, Series of positive and negative terms, Absolute convergence, Alternating series, Power series and their convergence, Taylor and Maclaurin series.

Unit 2: Complex Variables: Complex numbers, Complex plane, Modulus and argument representation of complex numbers, Roots of complex numbers, Complex functions and mappings, Complex analytical functions: curves and regions in the complex plane, complex functions, limit, derivative, analytic function, Cauchy-Riemann equations, elementary complex functions such as powers, exponential function, logarithmic, trigonometric and hyperbolic functions, Inverse functions, Harmonic functions.

Unit 3: Vector Calculus: Scalar and vector fields, Directional derivative & Gradient operator, Conservative fields and potential functions, Divergence and Curl of vector fields, Applications to different coordinate systems.

Unit 4: Fourier Series & Fourier Transform: Introduction to Fourier Series , Convergence of Fourier Series andtheir integration and differentiation, Euler formulae for Fourier coefficients , Functions having arbitrary period, Even and Odd functions , Half range expansions, Sine , Cosine and Exponential Fourier Series, Frequency and Amplitude Spectra of a function ,Fourier integral , Linearity property, Transform of derivatives, Convolution theorem, Fourier Transform Fourier Cosine and Sine Transforms.

Unit 5: Laplace Transform: Definitions, Fundamental Ideas, Operational Properties of the Laplace Transform, Linearity property, Transform of elementary functions, Laplace transforms of derivatives and integrals, Differentiation and Integration of transforms, Convolution theorem, Inversion Integral, Use of Laplace transforms in the solution of initial problem, Unit step function, Impulse function-transforms of step functions, Transforms of Periodic functions.

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig
2. Higher Engineering Mathematics, B.S. Grewal
3. Mathematical Methods, Potter and Goldberg
4. Mathematics for Engineers and Physicists, L.A. Pipes
5. Applied Mathematics for Mathematician & Engineers: L A Pipes (TMH)
6. Engineering Mathematics: H K Das (S Chand & Co. Ltd.)
7. Engineering Mathematics: B.S. Grewal (Khanna Pub.)

Paper-2: Database Management System (BCA 108)

Unit 1: Introduction: Data, information and knowledge, Characteristics of database approach, Data independence, Architecture of database system, Data dictionary, Types of database language, database system life cycle, Overview of hierarchical, network and relational model. Relations and Codd's rules, Concepts of keys.

Unit 2: Relation Algebra: Select, Project, Joins, Set operations, Update operations – tuple relational calculus, Relational Calculus vs. relational algebra. Data definition, data manipulation, view definition, nested queries, updation, Embedded SQL, Handling of nulls and cursors.

Unit 3: Data Models: Conceptual, Logical and Physical design, ER models, ER diagrams, Strong and weak entity sets, Generalization, Specialization and Aggregation, Conversion of ER model into relational schemas, Extended Relational Model & Object Oriented Database System; New Data Types, User Defined Abstract Data Types.

Unit 4: Normalization: Normalization concepts, Functional dependencies and dependency preservations, Normal forms – 1NF, 2NF, 3NF, BCNF, 4NF, 5NF, DKNF, De-normalization, Clustering of tables and indexes.

Unit 5: Transaction Handling: Transaction recovery, System recovery, two phase commit, concurrency problems, locking, deadlocks, security.

Distributed Database System: Structure of Distributed Database, Data Fragmentation, Query Processing, Algorithms For Executing Query Operations, Query Evaluation Plans, Pipelined Evaluations, Multimedia Databases.

References:

1. Introduction to Database System – C.J. Date
2. Database Systems – Mcfadden et.al.
3. Database Concepts – Navathe et.al.
4. Database Structured Techniques for Design Performance – S. Atre

Paper 3: Computer Organization and Architecture (BCA109)

Unit 1: Types of Processors, Scalar processors; concept of scalar pipelined processors; pipeline hazards- Structural Hazard, Data Hazard and Control Hazard; super pipelining; super scalar architecture.

Unit 2: Fixed Point Representation, Floating Point Representation, Error Detection Codes, Computer Arithmetic - Addition, Subtraction, Multiplication and Division Algorithms.

Unit 3: Comparative study of 8 bit , 16 bit and 32 bit processor families; Basics of Pentium Processors; Comparative study of Microcontrollers; Future Trends.

Unit 4: Memory management, Concept of virtual memory, Memory Organization- 2D and 3D, memory interleaving- Higher order interleaving and lower Order interleaving, I/O methods- Polled I/O, Interrupt driven I/O and Direct I/O, I/O addressing and I/O interfacing.

Unit 5: Assembler, Machine language instruction processor, Completeness of instruction set, Assembly language programs for common application problems such as Maximum finding, Summation, Sorting, Searching, Multiple precision arithmetic, Delay routines, etc.

References:

1. Digital System Design and Microprocessor: Hayes, John P.
2. Computer Architecture and Organization: Hayes, John P.
3. Computer System Architecture: Mano, M. M.

Paper 4: Data Structures (BCA110)

Unit 1: Introduction: Basic Terminology, Elementary Data Organization, Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big-Oh, Time-Space trade-off. Abstract Data Types (ADT) Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Application of arrays, Sparse Matrices and their representations. Linked lists: Array Implementation and Dynamic Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Generalized Linked List.

Unit 2: Stacks: Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Recursion, Tower of Hanoi Problem, Simulating Recursion, Principles of recursion, Tail recursion, Removal of recursion Queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue.

Unit 3: Trees: Basic terminology, Binary Trees, Binary Tree Representation: Array Representation and Dynamic Representation, Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Array and Linked Representation of Binary trees, Tree Traversal algorithms: Inorder, Preorder and Postorder, Threaded Binary trees, Traversing Threaded Binary trees, Huffman algorithm.

Unit 4: Graphs: Terminology, Sequential and linked Representations of Graphs: Adjacency Matrices, Adjacency List, Adjacency Multi list, Graph Traversal : Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transitive Closure and Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm, Introduction to Activity Networks.

Unit 5: Searching : Sequential search, Binary Search, Comparison and Analysis Internal Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Two Way Merge Sort, Heap Sort, Radix Sort, Practical consideration for Internal Sorting. Search Trees: Binary Search Trees(BST), Insertion and Deletion in BST, Complexity of Search Algorithm, AVL trees, Introduction to m-way Search Trees, B Trees & B+ Trees . Hashing: Hash Function, Collision Resolution Strategies Storage Management: Garbage Collection and Compaction.

References:

1. Horowitz and Sahani, “Fundamentals of Data Structures”, Galgotia Publications Pvt Ltd Delhi India.

2. Lipschutz, “Data Structures” Schaum’s Outline Series, Tata Mcgraw-hill Education (India) Pvt. Ltd.

Paper 5 : Software Engineering (BCA111)

Unit 1: Introduction to software engineering and software development life cycle models: Introduction to Software, Types of Software, Introduction to Software Engineering, Software Processes; SDLC: Introduction, Models.

Unit 2: Software Requirement and Quality Assurance: Requirement Engineering**,** Types of Requirements, SRS, Characteristics of SRS, DFD and ERD; Verification and Validation; Software quality Assurance: definition, Objectives, Goals and Plan; CMM.

Unit 3: System Design and Software Measurement: Design Objective, Design Principles, Modularization, Coupling and Cohesion; Software Metrics: Definition and Types

Unit 4: Software Testing and Maintenance: Testing Principles, Levels of Testing, White Box and Black Box Testing; Software Configuration Management, Need and Types of Maintenance, COCOMO.

Unit 5: Risk Management, CASE Tools and Case Studies: Risk Analysis; Project Scheduling; Reverse Engineering; Re-engineering. Introduction to CASE tools, Use and Application; Case Study: To analyse a problem and prepare a SRS document including DFD and ERD.

References:

1. Software Engineering: Ian Sommerville, Pearson Education
2. Software Engineering: R. S. Pressman, McGraw Hill
3. An Integrated Approach to Software Engineering: Pankaj Jalote

Paper-6: Principles of Management (BCA112)

Unit 1: Evolution of Management: - Contribution of Taylor, Mayo & Fayol, Different approaches of management, role of manager, tasks of a professional manager, Management functions. Level of Management, managerial skills at various levels. Planning & Decision making: - Definition, Nature for planning, importance, Process of planning, decision making, nature importance & process, types of plans. Management Vs Administration.

Unit 2: Planning: - Planning Concept, Process of Planning, Types of Planning, Advantages and Limitations of Planning, Decision Making-Stages in Decision Making. Corporate Planning; Environmental analysis and diagnosis, MIS and DSS.

Unit 3: Organization & staffing: - Definition, organizing process, importance of organizing, Organization Structures, Types, Advantages & Disadvantages. Authority & Responsibility, Human Resource Management, Manpower planning, Recruitment, Selection, Training & promotion, payroll system.

Unit 4: Motivation & Leadership:-Motivation concepts; Theories of Motivation. Theory X, Theory Y, Theory Z. Theories; – Maslow, Herzberg, and McGregor. Leadership Theories and Leadership Styles. Communication & control Communication Definition, importance, factors affecting communication methods, barriers & remedies.

Unit 5:Controlling -System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting, Effective Control System; Techniques of Control traditional and modern.

Reference:

1. Principles & Practice of Management – L. M. Prasad Management
2. Stoner and Freeman: Management; Prentice Hall, New Delhi
3. Hampton, David R: Modern Management; McGraw Hill, New York
4. Louis A. Allen: Management and Organisation; McGraw Hill, Tokyo

BCA233 Lab I: DBMS

BCA234 Lab II: Data Structures

SEMESTER III

Paper 1: Core JAVA (BCA113)

Unit 1: Introduction to Java and Its environment: Programming language types, Computer programming hierarchy, Why Java?,Flavors of Java, Java Designing goals, Features of Java, JVM, Bytecode, Installing Java, Java Program Development and Deployment, Java Source File Structure, Compilation (JIT, AIT), Execution, Naming conventions, Unicode systems, difference between JDK, JRE and JVM.

Unit 2: Basic Language Elements: Lexical Tokens, Identifiers, keywords, Literals, Comments, Datatypes, Operators and expressions; decision making, branching and looping.

Unit 3: Object Oriented Programming: Advantages of OOPs,Class Fundamentals, Object and Object Reference, Method Overloading, constructor, Static (Variable, Method and Block), this keyword, Inheritance (IS-A), Aggregation and Composition (HAS-A), method overriding, covariant return type, super keyword, instance initializer block, final keyword, runtime polymorphism, static and dynamic binding, abstract class and interface, down casting with instanceof operator, Access modifiers, encapsulations, object class, object cloning, Java Array, Call by value and call by reference strictfp keyword.

Unit 4: Package and Exception Handling: Organizing classes and Interfaces in packages, Package as Access Protection, Defining Package, Class path setting for packages, Making JAR files for Library packages, Import and Static import naming convention for packages. Exception and Errors, types of exception, control flow in exceptions, JVM reaction to exceptions, use of try, catch, finally, throw, throws in exception handling, in-build and user defined exception handling, checked and un-checked exceptions.

Unit 5: String and Input-Output in Java: String: what and why? Types of strings, string comparison, methods of string class, StringBuffer Class, StringBuilder Class, Creating Immutable String, toString Method, StringTokenizer class. FileOutputStream and FileInputStream, ByteArrayOutputStream, SequenceInput Stream, BufferedOutput Stream and BufferedInputStream, FileWriter and File Reader, Char Array Writer, Input from Keyboard by InputStreamReader, Input from Keyboard by console, input from keyboard by scanner, printStream class, PrintWriter class, Compressing and Uncompressing file, reading and writing data simultaneously, DataInputStream and DataOutputStream, Steam Tokenizer class.

References:

1. Burdman, “Collaborative Web Development”, Addison Wesley.
2. Ivan Bayross, “Web Technologies Part II”, BPB Publications.
3. Margaret Levine Young, “The Complete Reference: JAVA”, TMH
4. Naughton, Schildt, “The Complete Reference JAVA2”, TMH

Paper-2: Design & Analysis of Algorithms (BCA114)

Unit 1: Basics of an Algorithm: Definition and Example of an algorithm, Characteristics of an algorithm, Steps in Designing of Algorithms, Growth of function, Recurrence, Problem Formulation, Solving Recurrence Relations using Substitution Method, Iteration Method, Master Method. **Asymptotic Bounds**: Performance Analysis-Space Complexity, Time Complexity, Asymptotic Notations, Big Oh Notation O, Omega Notation Ω, Theta Notation θ and Little Oh Notation, Limiting Behavior Of Asymptotic Notations, Concept of efficiency of analysis of an algorithm, Basic Algorithms and Comparative efficiencies of algorithms: Linear, Quadratic, Polynomial and Exponential.

Unit 2: Searching: Linear Search, Binary Search and their Complexity Analysis. **Sorting:** Concept of Sorting, Selection Sort, Insertion Sort, Bubble Sort and their Complexity Analysis. **Linear Time Sorting**: Radix Sort. Counting Sort, Bucket Sort. **Divide and Conquer Approach**: Quick Sort and Merge Sort, Strassen's Matrix Multiplication.

Unit 3: Graph Algorithms and Trees: Cyclic graph, Acyclic graph, Directed Acyclic Graph, Representation of Graphs, Adjacency Matrix, Adjacency List, Depth First Search and Examples, Breadth First Search and Examples, Topological Sort. Greedy Method: **Minimum Spanning Tree:** Kruskal's Algorithms, Prim's Algorithms, **Shortest Path: Single Source**: Dijkstra, Bellman Ford, **All pair shortest Path:** Floyd's Algorithms **Dynamic Programming:** General approach, multi-stage graph, matrix-chain multiplication, all-pairs shortest paths, travelling salesperson, 0/1 knapsack problem, longest common subsequence.

Unit 4: Backtracking: N-queen problem, sum of subsets, knapsack problem, generation of all cliques, traveling salesperson problem, Graph coloring. **Branch-and-Bound:** Assignment problem, 0/1 knapsack problem. **Randomizing Algorithms:** Numerical Integration, Primality testing, randomized min-cut, randomized algorithm for n-queens, quick-sort.

Unit 5: Approximation and Lower Bound Theory: Job scheduling, Bin packing, set cover, Max cut. **Lower Bound Theory:** Decision tree; Reduction method; NP-completeness, Cook's Theorem, Examples of NP-Hard and NP-Complete problems

References:

1. Fundamental of Computer algorithms – Horowitz and Sahni
2. The art of Computer Programming – Donald Knuth
3. Design Methods and Analysis of Algorithms – S.K. Basu
4. The Design and Analysis of Computer Algorithms – Aho, Hopcraft and Ullaman
5. Genetic Algorithm in Search, Optimization and Machine Learning – David E. Goldberg

Paper 3: Introduction to System Software (BCA115)

Unit 1: General concepts-Review of assembly and machine language programming, distinction between system software and application software, Language processors:- Introduction, Language processing activities.
Assemblers:- Elements of Assembly language programming, A simple assembly scheme, Pass structure of assemblers, Design of two pass assemblers.
Unit 2: Macros and macro processors:- Macro definition and call, Macro expansion, Nested macro calls, advanced macro facilities, design of macro pre processor Linker-Relocation and linking concepts-self relocating programs. Loader-Types of loaders Editor-Types of editors-Components of editor-Debug monitor.
Unit 3: Introduction to compiling:- Compilers, Analysis of a source program, the phases of a compiler, Lexical analysis:-The role of the lexical analyzer, Input buffering, specification of tokens Recognition of tokens, Finite automata, Conversion of an NFA to DFA, From a regular expression to an NFA.
Unit 4: Syntax analysis:- the role of the parser, Context free grammars, writing a grammer, Top dowm parsing Bottom up parsing, syntax directed translation-syntax directed definition, Construction of Syntax Tree, L R parsers-LR parsing algorithm, Constructing SLR parsing tables, SLR parsing table.
Unit 5: Intermediate code generation-postfix notation, syntax tree, three-address code, basic blocks and flow graph, the DAG representation of basic blocks, Backpatching, Code optimization:- The principal sources of optimization, optimization of basic blocks, loops in flow graphs, Peephole optimization Code Generations:- Issues in the design of a code generator, simple code generator.
References:
1. Systems Programming- Donovan
2. Introduction to Systems Software- Dhamdhere D.M.

Paper 4: Principles of Programming Languages (BCA116)

Unit 1: Introduction: The Role of Programming Languages: Why Study Programming Languages, Towards Higher-Level languages, Programming paradigms, Programming environments. Language Description: Syntactic structure, language Translation Issues: Programming language Syntax, Stages in translation, Formal translation Models.

Unit 2: Language Properties: Modeling Language Properties, Elementary Data Types, Encapsulation, Inheritance, Sequence Control, Subprogram Control.

Unit 3: Programming Paradigms: Imperative Programming: Statements, Types, Procedure Activations Object-Oriented Programming: Grouping of Data and Operations, object oriented programming Functional Programming: Elements, Programming in a typed language, Programming with lists.

Unit 4: Other Programming Paradigms: Logic Programming, Concurrent Programming, Network Programming, Language Description: Semantic Methods.

Unit 5: Lambda Calculus: Introduction to Lambda Calculus, Simple types, Sub-typing

References:

1. "Programming Languages: Design and Implementations" , Terrance W.Pratt, Marvin V.Zelkowitz, T.V.Gopal, Fourthed, Prentice Hall
2. "Programming Language Design Concept", David A. Watt, Willey India
3. "Programming languages: Concepts and Constucts", Ravi Sethi, Second Ed.,Pearson.
4. "Types and programming Languages", Benjamin C. Pierce. The MIT Press Cambridge, Massachusetts London, England.

Paper 5: Fundamentals of Computer Networks (BCA117)

Unit 1: Introduction: History of data communication, Open system standard, Definition of communication link andits application in telephony and computer networks, Importance of channel bandwidth and system noise, Protocols in telephony and internet communication, Types of channel, Advantages and disadvantages of analog and digital transmissions, Digitizing Speech, Wave form coding and companding, Voice over IP.

Unit 2: Data Transmission Basics: Synchronous/Asynchronous, Error detection and correction methods, Data compression, Protocol basic, Circuit, Message, Packet and Cell switching, Connection oriented and connectionless services, importance of modulation and multiplexing in communication: introduction to different modulation and multiplexing techniques; importance of Nyquist Criterion and Shannon's theorem in communication; delay, bandwidth, throughput and noise.

Unit 3: Computer Networks: Advantages and disadvantages of computer networks; classification of computer networks; introduction to various physical media in connection oriented and connection less networks; network protocols and their role in computer network. Layered approach to network design- ISO/OSI and TCP/IP model.

Unit 4: Network Topology and Network Devices: Network topology, LAN wired/wireless, Ethernet, CSMA/CD, CSMA/ CA, Token passing rings, FDDI, Introduction to networking devices- repeaters, hubs, Switches, Bridges, Routers and gateways, Switching techniques: Store and forward, Filter, Next-Hop forwarding, Introduction to routing techniques- Link state routing and distance Vector routing.

Unit 5: Internetworking: IP addressing, Address binding with ARP, Datagram encapsulation and fragmentation, Sub-netting and implementation of CIDR, UDP and TCP, TCP segment format, Adaptive retransmission, ICMP and error handling. Network applications, Client-Server concepts and application, DNS, HTTP, Email and web browsing, Broadband Multi-Service networks, Cell based networks, ISDN.

References:

1. Computer Networks :Tanenbaum, A.S
2. Data and Computer communication :Stallings, William
3. Inter Networking With TCP/IP Vol I, II,III: Comer, D.E. and Stevens D.L.
4. Local Networks : Stalling, William
5. Data Communication and Networking : Forouzan, B.A

Paper 6: Linux and Shell Programming (BCA118)

Unit 1: Introduction To Linux And Linux Utilities: A brief history of LINUX, architecture of LINUX, features of LINUX, introduction to vi editor. Linux commands- PATH, man, echo, printf, script, passwd, uname, who, date, stty, pwd, cd, mkdir, rmdir, ls, cp, mv, rm, cat, more, wc, lp, od, tar, gzip, file handling utilities, security by file permissions, process utilities, disk utilities, networking commands, unlink, du, df, mount, umount, find, unmask, ulimit, ps, w, finger, arp, ftp, telnet, rlogin.Text Processing utilities and backup utilities , tail, head , sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio.

Unit 2: Introduction to Shells and Filters: Linux Session, Standard Streams, Redirection, Pipes, Tee Command, Command Execution, Command-Line Editing, Quotes, Command Substitution, Job Control, Aliases, Variables, Predefined Variables, Options, Shell/Environment Customization. Filters: Filters and Pipes, Concatenating files, Display Beginning and End of files, Cut and Paste, Sorting, Translating Characters, Files with Duplicate Lines, Count Characters, Words or Lines, Comparing Files.

Unit 3: File Structure and Management: Grep: Operation, grep Family, Searching for File Content. Sed: Scripts, Operation, Addresses, commands, Applications, grep and sed. UNIX FILE STRUCTURE: Introduction to UNIX file system, inode (Index Node), file descriptors, system calls and device drivers. File Management: File Structures, System Calls for File Management – create, open, close, read, write, lseek, link, symlink, unlink, stat, fstat, lstat, chmod, chown, Directory API – opendir, readdir, closedir, mkdir, rmdir, umask.

Unit 4: Process and Signals: Process, process identifiers, process structure: process table, viewing processes, system processes, process scheduling, starting new processes: waiting for a process, zombie processes, orphan process, fork, vfork, exit, wait, waitpid, exec, signals functions, unreliable signals, interrupted system calls, kill, raise, alarm, pause, abort, system, sleep functions, signal sets. File locking: creating lock files, locking regions, use of read and write with locking, competing locks, other lock commands, deadlocks.

Unit 5: Inter Process Communication: Pipe, process pipes, the pipe call, parent and child processes, and named pipes: fifos, semaphores: semget, semop, semctl, message queues: msgget, msgsnd, msgrcv, msgctl, shared memory: shmget, shmat, shmdt, shmctl, ipc status commands. **Introduction to Sockets**: Socket, socket connections - socket attributes, socket addresses, socket, connect, bind, listen, accept, socket communications.

References:

1. Linux & Shell Programming
2. Beginning Shell Scripting by Erick Foster-Johnson, Wiley India
3. Beginning Linux Programming, Neil Mathew, Richard Stones, Wiley India

BCA235 Lab I: Core Java
BCA236 Lab II: LINUX & Shell Programming

SEMESTER IV

Paper 1: Operating Systems (BCA119)

Unit 1: Introduction: Definition, Objectives and Functions, Types of Operating Systems, Generations of Operating Systems, Desirable Qualities of OS, Operating Systems Examples: DOS, Unix/Linux, Windows, MAC OS and Android.

Unit 2: Process Concepts: Process: Definition, Life Cycle of a Process; System Calls for Process Management, Process Scheduling, Scheduling Algorithms: First Come First serve (FCFS), Shortest Job First (SJF), Round Robin (RR), Shortest remaining time next (SRTN), Priority Based Scheduling or Event Driven (ED) Scheduling, Performance Evaluation of the Scheduling Algorithms.

Unit 3: Interprocess Communication, Synchronization and Deadlock: Interprocess Synchronization, Mutual exclusion, Semaphores, Interprocess Communication, Conditional critical regions and monitors, Deadlock, Characterization of a Deadlock, Resource Allocation Graph, Deadlock Prevention, Deadlock Avoidance, Banker's Algorithm.

Unit 4: Memory Management: Overlays and Swapping, Logical and Physical Address Space, Paging: Principles of operation, Page allocation, Hardware Support for Paging, Protection and Sharing; Segmentation: Principles of operation, Address Translation, Protection and Sharing; Virtual Memory: Principles of operation, Virtual Memory management, Protection and sharing; Page Replacement Strategies.

Unit 5: I/O and File Management: Organization of I/O Functions, I/O Buffering, Disk Scheduling, RAID; File Concept, Access Methods, Directory Structures, Protection.

References:

1. Introduction to Operating Systems: Deitel
2. Operating System Concepts: Peterson and Silbershatz
3. Modern Operating Systems: Andrew S Tanenbaum
4. Operating Systems, Internals and Design Principles, William Stallings

Paper 2: Machine Learning Techniques (BCA120)

Unit 1: I**ntroduction**: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation. Linear regression, Decision trees, overfitting. Learning – Types of Machine Learning Supervised Learning, Design a Learning System : Perspectives and Issues in Machine Learning **,**Unsupervised learning, Ensemble learning. Feature engineering in Machine Learning.

Unit 2 Unsupervised Learning – K means Algorithms, Vector Quantization ,Self Organizing Feature Map. Instance based learning, Feature reduction, Probability: Probability and Bayes learning, Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model.

Unit 3: Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.
Neural network: Perceptron, multilayer network, back propagation, introduction to deep neural network.

Unit 4: Learning with Trees: Decision Trees, Constructing Decision Trees, Classification and Regression Trees – Ensemble Learning, Boosting, Bagging, Different ways to Combine Classifiers, Probability and Learning, Data into Probabilities, Basic Statistics, Gaussian Mixture Models, nearest neighbour methods.

Unit 5: Dimensionality Reduction and Evolutionary Models : Dimensionality Reduction :Linear Discriminant Analysis ,Principal Component Analysis, Factor Analysis ,Independent Component Analysis, Locally Linear Embedding, Isomap, Least Squares Optimization, Evolutionary Learning ,Genetic algorithms, Genetic Offspring, ,Genetic Operators, Using Genetic Algorithms, Reinforcement Learning :Overview , Getting Lost Example , Markov Decision Process.

References:

1. Miroslav Kubat: An introduction to machine Learning, Springer
2. John Slavio: Machine Learning for Beginners
3. Rajiv Chopra: Machine Learning, Khanna Publications
4. Gareth Witten, James Daniela et al: An introduction to Statistical Learning with applications in R

Paper 3: Compiler Design (BCA121)

Unit 1: Introduction to Compiler, Phases and passes, Bootstrapping, Finite 8 state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX-compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG.

Unit 2: Basic Parsing Techniques: Parsers, Shift reduce parsing, operator 8 precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables.

Unit 3: Syntax-directed Translation: Syntax-directed Translation schemes, 8 Implementation of Syntax-directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser. More about translation: Array references in arithmetic expressions, procedures call, declarations and case statements.

Unit 4: Symbol Tables: Data structure for symbols tables, representing scope information. Run-Time Administration: Implementation of simple stack allocation scheme, storage allocation in block structured language. Error Detection & Recovery: Lexical Phase errors, syntactic phase errors semantic errors.

Unit 5: Code Generation: Design Issues, the Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator. Code optimization: Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.

References:

1."Principles Of Compiler Design" by Alfred V Aho.
2. Express Learning – Principles of Compiler Design" by ITL ESL.
3. Compiler Design" by Chattopadhyay.

Paper 4: Introduction to Artificial Intelligence (BCA122)

Unit 1: Introduction: Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Possessing.

Unit 2: Introduction to Search: Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.

Unit 3: Knowledge Representation & Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

Unit 4: Machine Learning: Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models, Learning with hidden data - EM algorithm, Reinforcement learning.

Unit 5: Pattern Recognition: Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parameter estimation methods - Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbour (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

References:

1. Artificial Intelligence: Rich and Knight
2. Artificial Intelligence: A Modern Approach: Stuart Russell and Peter Norvig
3. Introduction to Artificial Intelligence: Partick Winston

Paper 5: OOPS with Python (BCA123)

Unit 1: Object oriented programming paradigm: Basic concepts of object oriented programming, Benefits of OOP: Object-oriented features, Applications of OOP. Algorithms and programming. A simple Python program, Structure of python program, assignment statements, data types in python, Control Flow in python, variables, operators in python, control flow-conditionals, loops.

Unit 2: Introduction to Python Data structures Types, expressions, strings, lists, tuples , Python memory model: names, mutable and immutable values, List operations: slices , Binary search, Inductive function definitions, Elementary inductive sorting: selection and insertion sort, In-place sorting. List- (Slicing, Indexing, Concatenation, other operations on Sequence data type), concept of mutability, Examples to include finding the maximum, minimum, mean; linear search on list/ tuple of numbers.

Unit 3: Class, objects and user defined Data type: Abstract Data type, class, objects, classes and objects in python, abstract class, Features of OOPs in python (abstraction, encapsulation, inheritance and polymorphism), Scope in Python: local, global, nonlocal names. Multithreading: Is it supported by python?

Unit 4: Dictionaries and Python functions: Dictionary basics and counting the frequency of elements in a list using a dictionary. Functions, optional arguments, default values, Passing functions as arguments, Higher order functions on lists: map, lambda, list comprehension, basic input/output Handling files String processing.

Unit 5: NumPy Basics: Introduction to NumPy, ndarray, datatypes , array attributes, array creation routines, Array From Existing Data, Array From Numerical Ranges, Indexing & Slicing.

References:

1. Gowrishankar S, Veena A, “Introduction to Python Programming”, 1st Edition, CRC Press/Taylor & Francis, 2018.
2. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, 1st Edition, O'Reilly Media, 2016.
3. AurelienGeron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems”, 2nd Edition, O’Reilly Media, 2019.

Paper 6: Principles of Cyber Security and Cryptography (BCA124)

Unit 1: Foundations of. Cyber Security Concepts: Essential Terminologies: CIA, Risks, Breaches, Threats, Attacks, Exploits. Information Gathering (Social Engineering, Foot Printing & Scanning).Open Source/ Free/ Trial Tools: nmap, zenmap, Port Scanners, Network scanners. **Cyber Security Vulnerabilities & Safe Guards:** Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Authorization, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview Access control, IT Audit, Authentication.

Unit 2: Cyber Laws and Forensics: Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013 Introduction to Cyber Forensics, Need of Cyber Forensics, Cyber Evidence, Documentation and Management of Crime Sense, Image Capturing and its importance, Partial Volume Image, Web Attack Investigations, Denial of Service Investigations, Internet Crime Investigations, Internet Forensics, Steps for Investigating Internet Crime, Email Crime Investigations.

Unit 3: PUBLIC KEY CRYPTOGRAPHY AND RSA: Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Principles Public key crypto Systems, Diffie Hellman, Key Exchange, the RSA algorithm, Key Management, Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques. **BLOCK CIPHER AND DATA ENCRYPTION STANDARDS**: Block Cipher Principles, Data Encryption Standards, the Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles.

Unit 4: ADVANCED ENCRYPTION STANDARDS: Evaluation Criteria for AES, the AES Cipher. MORE ON SYMMETRIC CIPHERS: Multiple Encryption, Triple DES, Block Cipher Modes of Operation, Stream Cipher and RC4 **MESSAGE AUTHENTICATION AND HASH FUNCTIONS**: Authentication Requirement, Authentication Function, Message Authentication Code, Hash Function, Security of Hash Function and MACs.

Unit 5: Malware: Explanation of Malware, Types of Malware: Virus, Worms, Trojans, Rootkits, Robots, Adware's, Spywares, Ransom wares, Zombies etc., OS Hardening (Process Management, Memory Management, Task Management, Windows Registry/ services another configuration), Malware Analysis. Open Source/ Free/ Trial Tools: Antivirus Protection, Anti Spywares, System tuning tools, Anti Phishing. **FIREWALL**: Firewall Design principles, Trusted Systems. **DIGITAL SIGNATURE**: Digital Signature, Authentication Protocol, Digital Signature Standard.

References:

1. Security in Computing by Charles P. Pfleeger (Prentice Hall).
2. Computer Security Handbook Vol. 1 & 2 by Bosworth, Kabay&Whyne (Wiley).
3. Applied Cryptograph by Schneier, Bruce (Wiley).
4. Practical Cryptography by Schneier& Ferguson (Wiley).
5. Introduction to cryptography: Principles and applications by Delfs&Knebl (Springer).

BCA237 Lab I: Machine Learning Lab

BCA238 Lab II: PYTHON Programming Lab

SEMESTER V

Paper-1: .Net Framework & C# (BCA125)

Unit 1: The .Net Framework and OOP in .Net: Introduction, DLL Hell, CLR, CTS, MSIL, Base Class Library, Namespace and its importance, System Namespace & Other Important Namespaces, Class / Object, Inheritance, Polymorphism, Abstract Class, Interfaces, Events & Delegates.

Unit 2: Basic C# and Win Forms Programming: Introduction, Data Types, Identifiers, Arrays, Error Handling. Introduction, Window Controls – TextBox, CheckBox, Combo, PictureBox, Menu, Tab, Progress Bar, List View, Report Viewer.

Unit 3: Process And Threads: Threads, Creation/Stopping of Threads, Thread Pool Concept, Synchronizing Multiple Threads: Monitor class, Mutex, Semaphore.

Unit 4: Assemblies & Their Importance: Assemblies, Private Assembly, Signing an Assembly, Shared Assemblies, Satellite Assemblies, GAC and assembly installation. RTTI and Reflection

Unit 5: ADO.NET: ADO.NET classes hierarchy, Connection, Command, DataSet, DataReader, DataAdapter, SqlDataSource.

References:

1. C#: The Complete Reference by Herbert Schildt
2. C# Black Book by Matt Telles
3. Complete Reference ASP. Net by MacDonand, TMH
4. C# Programming Bible by Jeff Ferguson, Brian-Patterson, Wiley
5. Wrox's Visual C# 2005 Express Edition, by F. Scott-Barker, Wiley

Paper 2: Optimization Techniques (BCA126)

Unit 1: Historical Development; Engineering applications of Optimization; Art of Modeling, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems. Classification of optimization problems, Optimization techniques –classical and advanced techniques, Introduction to Operation Research: Operation Research approach, scientific methods, introduction to models and modeling techniques, general methods for Operation Research models, methodology and advantages of Operation Research.

Unit 2: Linear Programming (LP): Introduction to LP and formulation of Linear Programming problems, Graphical solution method, alternative or multiple optimal solutions, Unbounded solutions, Infeasible solutions, Maximization – Simplex Algorithm, Minimization – Simplex Algorithm using Big-M method, Two phase method, Duality in linear programming, Integer linear programming.

Unit 3: Allocation problems and Game Theory: Introduction to Transportation problems, Transportation problem –Methods of basic feasible solution -Optimal solution–MODI Method. Assignment problem-Hungarian method - Game theory: Two people-zero sum game-mixed stages -Dominance properties.

Unit 4: Sequential optimization; Representation of multi stage decision process Types of multi stage decision problems; Concept of sub optimization and the principle of optimality. Recursive equations –Forward and backward recursions; Computational procedure in dynamic programming (DP), Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP; Problem formulation and application in Design of continuous beam and optimal geometric layout of atruss.

Unit 5: Network Analysis: Network definition and Network diagram, probability in PERT analysis, project time cost trade off, introduction to resource smoothing and allocation Sequencing: Introduction, processing N jobs through two machines, processing N jobs through three machines, processing N jobs through m machines. Inventory Model: Introduction to inventory control, deterministic inventory model, EOQ model with quantity discount.

References:

1. Optimization: Theory and Practice" by G S G Beveridge and R S Schechter.
2. Introduction to Optimization Techniques" by M Aoki.
3."Optimization Techniques" by L R Foulds.

Paper 3: Computer Graphics (BCA127)

Unit 1: Video-Display Devices, Raster-Scan and Random-Scan Systems; Color Models; Color CRT-Beam Penetration Method, Shadow Mask Method, Flat Panel Display-Emissive and Non emissive devices, interactive devices.

Unit 2: Line Drawing Algorithms- DDA, Bresenham's Line drawing algorithm, Mid-Point Circle and Ellipse Algorithms; Area Filling Algorithms- Scan Line Polygon Fill Algorithm, Boundary-Fill and Flood-Fill algorithms.

Unit 3: 2D and 3D transformations: Translation, Scaling, Rotation, Reflection and Shear Transformations; Matrix Representations and Homogeneous Coordinates; Composite Transforms.

Unit 4: Transformations Between Coordinate Systems, Viewing Pipeline, Viewing Coordinate Reference Frame, Window to View-Port Coordinate Transformation, Viewing Functions, Line clipping algorithms- Cohen Sutherland algorithm, Liang Barsky Line Clipping algorithm, Mid-Point subdivision algorithm, Cyrus Beck algorithm; and Polygon Clipping Algorithms, Projections-Parallel and Perspective.

Unit 5: Curves and their representation- Implicit, Explicit and Parametric representations; Spline Representation, Hermite Interpolation, Bezier and B-Spline Curves; Bezier and B-Spline Surfaces.

References:

1. Computer Graphics: Principles and Practice: Foley et al.
2. Computer Graphics: Hern and Baker
3. Procedural elements in Computer Graphics: David F. Rogers
4. Computer Graphics: A. Plastock and Gordon Kelley

PAPER 4: Fundamentals of Data Science (BCA128)

Unit 1: The Way of the Program, Variables, Expressions and Statements, Functions, Conditionals and Recursion, Functions, Iteration, Strings, Lists, Dictionaries, Tuples.
Unit 2: NumPy Basics: Arrays and Vectorized Computation, Getting Started with Pandas, Data Loading, Storage, and File Formats.
Unit 3: Data Cleaning and Preparation, Data Wrangling: Join, Combine, and Reshape, Making Sense of Data through Advanced Visualization, Data Aggregation and Group Operations.
Unit 4: Data Analysis Examples: Gov Data from Bitly, MovieLens Dataset, Food Database, Election Commission Database, Inferential Statistics, Uncovering Machine Learning.
Unit 5: Performing Predictions with Linear Regression, Pushing Boundaries with Ensemble Models, Applying Segmentation with k-means Clustering.

References:

1. Foundations of Data Science, Avrim Blum, John Hopcroft, Ravindran Kannan

PAPER 5: ELECTIVE I (BCA129 A/B/C)

Digital Image Processing (BCA129 - A)

Unit 1: Introduction: Image representation and modeling, 2-D linear system, Luminance, Contrast and Brightness, Color representation, Visibility functions, Monochrome and color vision model.

Unit 2: Image Quantization and Image Transforms: Sampling theorem, Anti-aliasing, image quantization, Orthogonal and unitary transforms, DFT, Cosine transform, Hadamard transform, Haar transform, KL transform.

Unit 3: Image Enhancement: Point operation, Histogram modeling, Filtering and spatial operations, Transform operations, Multi-spectral Image Enhancement

Unit 4: Image Restoration: Image formation models, Noise models, Inverse and Wiener filtering, Least square filters,Recursive filters, Maximum entropy method, Blind de-convolution, Bayesian method of noise removal, Image reconstruction,

Unit 5: Data Compression: Data compression vs. Bandwidth, Pixel coding, Predictive coding, Transform coding, Coding of two-tone images.

References:

1. Fundamentals of Digital Image Processing: Anil K. Jain
2. Digital Image Processing: R. Chellappa
3. Image Processing for Scientific Applications: Bernd Jahne
4. Digital Image Processing: R.C. Gonzalez & R.E. Woods

Cyber Ethics (BCA129 - B)

Unit 1: Introduction to Cyber Law, Evolution of computer technology, emergence of cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace-Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.

Unit 2: Information Technology Act, Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.

Unit 3: Cyber Law and Related Legislation, Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet, Alternative Dispute Resolution , Online Dispute Resolution (ODR).

Unit 4: Electronic Business and Legal Issues, Evolution and development in E-commerce, paper vs paper less contracts E-Commerce models- B2B, B2C, E security. Business, taxation, electronic payments, supply chain, EDI, E-markets, Emerging Trends.

Unit 5: Cyber Ethics, The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.

References:

2. Ethics for the Information Age, 7th edition, by M. J. Quinn
3. Cyberethics: Morality and Law in Cyberspace: Morality and Law in Cyberspace. Richard A.
4. Cyberethics, 6th Edition [Book] - O'Reilly Media

Artificial Neural Networks & Deep Learning (BCA129 - C)

Unit 1: Historical context and motivation for deep learning; basic supervised classification task, optimizing logistic classifier using gradient descent, stochastic gradient descent, momentum, and adaptive sub-gradient method.

Unit 2: Neuron as basic unit of neurobiology, perceptron as a model of learning, perceptron convergence theorem, batch perceptron learning algorithm, relation between perceptron and Bayesian learner for a Gaussian environment; linear regression model, maximum a posteriori (MAP) estimation of the parameter vector, least mean squares algorithm.

Unit 3: Neural Networks types: Feed forward neural networks, deep networks, regularizing a deep network, model exploration, and hyperparameter tuning. Multilayer Perceptrons: Back propagation algorithm, batch learning and online learning, adaptive control of learning rate; estimating regularization parameter: Tikhonov's regularization theory, complexity regularization, and network pruning. Kernel Methods and Support Vector Machines: Separability of patterns, interpolation problem, radial basis function (RBF) networks, support vector machines. Introduction to Hopefield networks, Boltzmann machines, restricted Boltzmann

Unit 4: Convolution Neural Networks: Introduction to convolution neural networks: stacking, striding and pooling, applications like image, and text classification.Sequence Modeling:Recurrent Nets: Unfolding computational graphs, recurrent neural networks (RNNs), bidirectional RNNs, encoder-decoder sequence to sequence architectures, deep recurrent networks.

Unit 5: Auto-encoders: Under complete autoencoders, regularized autoencoders, sparse autoencoders, de-noisingauto-encoders, representational power, layer, size, and depth of auto-encoders, stochastic encoders and decoders. Structuring Machine Learning Projects: Orthogonalization, evaluation metrics, train/dev/test distributions, size of the dev and test sets, cleaning up incorrectly labeled data, bias and variance with mismatched data distributions, transfer learning, multi-task learning.

References:

1. Ian Goodfellow, **Deep Learning**, MIT Press, 2016.
2. Jeff Heaton, **Deep Learning and Neural Networks**, Heaton Research Inc, 2015.
3. Mindy L Hall, Deep Learning, VDM Verlag, 2011.

BCA239 Lab I: Lab in C#

BCA240 Mini Project

SEMESTER VI

Paper 1 : DATA WAREHOUSING AND DATA MINING (BCA130)

Unit 1: Data warehouse: Introduction to Data warehouse, Difference between operational database systems and data warehouses, Data warehouse Characteristics, Data warehouse Architecture and its Components, Extraction Transformation-Loading, Logical(Multi-Dimensional), Data Modeling, Schema Design, Star and Snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non Addictive Measures; Fact-Less-Facts, Dimension Table Characteristics; OLAP Cube, OLAP Operations, OLAP Server Architecture- ROLAP, MOLAP and HOLAP.

Unit 2: Data Mining Introduction: Fundamentals of data mining, Application and Trends in Data Mining, Data Mining Functionalities, Classification of Data Mining systems, Integration of a Data Mining System with a Database, Major issues in Data Mining. Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration &Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

Unit 3: Association Rules: Association Rule Mining Single Dimensional Boolean Association Rules From Transactional Databases, Support and Confidence Measures, Association Rule Generation; APRIOIRI Algorithm, The Partition Algorithms, FP-Growth Algorithms, Compact Representation of Frequent Item Set-Maximal Frequent Item Set, Closed Frequent Item Set.

Unit 4: Classification and Prediction: Problem Definition, General Approaches to solving a classification problem, Evaluation of Classifiers , Classification techniques, Decision Trees-Decision tree Construction, Methods for Expressing attribute test conditions, Measures for Selecting the Best Split, Algorithm for Decision tree Induction ; Naive-Bayes Classifier, Bayesian Belief Networks; K- Nearest neighbour classification-Algorithm and Characteristics ,prediction: Accuracy and Error measures, Evaluating the accuracy of a classifier or a predictor, Ensemble methods.

Unit 5 Clustering: Clustering Overview, A Categorization of Major Clustering Methods, partitioning methods, hierarchical methods, , partitioning clustering-k-means algorithm, pam algorithm; hierarchical clustering-agglomerative methods and divisive methods, Basic Agglomerative Hierarchical Clustering Algorithm, Key Issues in Hierarchical Clustering.

References:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
2. K.P. Soman, ShyamDiwakar and V. Aja, “Insight into Data Mining Theory and Practice”, Eastern Economy Edition, Prentice Hall of India.
3. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Eastern Economy Edition, Prentice Hall of India.
4. Daniel T.Larose, “Data Mining Methods and Models”, Wiley-Interscience.

PAPER 2: ELECTIVE II (BCA131 – A/B/C)

Computer Vision (BCA131 - A)

Unit-1: Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis.

Unit-2: Edge detection, Edge detection performance, Hough transform, corner detection

Unit-3: Segmentation, Morphological filtering, Fourier transform, Recent trends in Activity Recognition, computational photography, Biometrics.

Unit-4: Feature extraction, shape, histogram, color, spectral, texture, using CV IP tools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing

Unit-5: Pattern Analysis: Clustering: K-Means, K-Medoids, and Mixture of Gaussians. Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised. Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.

References:

1. Concise Computer Vision by Reinhard Klette
2. Computer Vision: Algorithms and Applications by Richard Szeliski.
3. Deep Learning, by Goodfellow, Bengio, and Courville.

Parallel Computing (BCA131 - B)

Unit 1: Introduction to Parallel Computing: Scope of Parallel Computing, Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques.

Unit 2: Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.

Unit 3: Basic Communication Operations: One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-toAll Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

Unit 4: Analytical Modelling of Parallel Programs: Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Other Scalability Metrics.

Unit 5: Programming Using the Message-Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators.

References:

1. Introduction to Parallel Computing by Ananth Grama, Anshul Gupta, Gorge Karypis, Vipin Kumar, Pearson.

Distributed Systems (BCA131 - C)

Unit 1: Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks ,Lamport's & vectors logical clocks. Concepts in Message Passing Systems: causal order, total order, total causal order, Techniques for Message Ordering, Causal ordering of messages, global state, and termination detection.

Unit 2: Distributed Mutual Exclusion: Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non token based algorithms, performance metric for distributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms.

Unit 3: Agreement Protocols: Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system. Distributed Resource Management: Issues in distributed File Systems, Mechanism for building distributed file systems, Design issues in Distributed Shared Memory, Algorithm for Implementation of Distributed Shared Memory.

Unit 4: Failure Recovery in Distributed Systems: Concepts in Backward and Forward recovery, Recovery in Concurrent systems, Obtaining consistent Checkpoints, Recovery in Distributed Database Systems. Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols

Unit 5: Transactions and Concurrency Control: Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control. Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.

References:

1. Vijay K.Garg Elements of Distributed Computing , Wiley
2. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Education
3. Tenanuanbaum, Steen, "Distributed Systems", PHI