

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK

MOUNT CARMEL COLLEGE, AUTONOMOUS, BENGALURU

INTRODUCTION:

A nation's journey is largely scripted by the quality of its human resources. India, home to world's largest young population, needs to strengthen the human capital in terms of knowledge and skills so that the dream of Viksit Bharat by 2047 is achievable. This needs a curriculum framework which emphasises on Learning Outcomes so that higher education is empowering the students with the right set of Knowledge, Attitude and Skills.

UGC's Learning Outcomes based Curriculum Framework (LOCF) aims at holistic experience for students which focuses on both knowledge acquisition and application of knowledge. LOCF also seeks to empower the students with the necessary skills in a Tech-driven Knowledge economy – critical thinking, problem-solving, analytical reasoning, cognitive skills and lifelong self-learning.

Based on the LOCF given by UGC, Mount Carmel College, Autonomous proposes the following template which will be adopted by all the Departments for curriculum revision and adoption of outcome-based approach.

GRADUATE ATTRIBUTES

Mount Carmel College, Autonomous offers graduate and postgraduate programs which empower graduates with the following attributes:

- In-depth knowledge and ability to apply this in real world situations
- Critical, creative and evidence-based thinking to be problems-solvers
- Excellent communication skills to convey thoughts and ideas appropriately & innovatively
- Agile learners who can keep pace with a rapidly transforming digitalized world
- Ability to take up leadership roles and work in multi-cultural teams
- A desire to see themselves as continuous learners and seek new knowledge and skills
- To be responsible citizens with sound ethical values and concern for the community

QUALIFICATION DESCRIPTORS

The students who complete three years of full-time study of an undergraduate programme of study will be awarded a Bachelor's Degree (BA/B.Sc./B.Com/BBA/BCA/B.Voc); Students who complete four years of full-time study of an undergraduate programme will be awarded a Bachelor's Degree Honours. The Graduates of the degree program will demonstrate:

- An in-depth understanding in the chosen discipline, comprising theoretical and practical perspectives, and a basic understanding of emerging areas of study and practice.
- Ability to apply knowledge to comprehend the dynamics of the work-place, society and world in order to find efficient and ethical solutions to problems.
- Basic quantitative and digital skills for undertaking analysis, interpreting results and arriving at logical conclusions.
- Comprehensive knowledge about current topics and basic skills required to comprehend contemporary issues.

FRAMEWORK FOR OUTCOME BASED CURRICULUM FOR A PROGRAM

VISION OF THE DEPARTMENT

The Department of Computer Science, envisions a skill based technical education that empowers the students through necessary domain knowledge and prepare them to meet the dynamic challenges so as to deliver high quality services for the betterment of the society.

INTRODUCTION OF THE PROGRAM

The Bachelor's program in Computer Science is a three-year undergraduate programme that provides students with a comprehensive understanding of theoretical and practical aspects of Computer Science. The curriculum covers diverse areas such as programming, algorithms, data structures, artificial intelligence, and many more and also include internships and research and practical projects to provide students with hands-on experience in the field. The program emphasizes the development of critical thinking, problem-solving, and collaboration skills, which are essential for success in the professional world. The program is designed to produce graduates who can apply their knowledge to real-world situations and advance technology to solve complex computational problems and contribute to the society.

PROGRAM LEARNING OUTCOMES

PLO1	Gain theoretical and practical knowledge in the core and allied areas of Computer Science and apply them in developing solutions to the problems.
PLO2	Demonstrate the ability of problem-solving and establish excellent skills in applying various design strategies for solving complex problems.
PLO3	Identify appropriate modern and IT tools for modeling, predicting, analyzing, and delivering solutions to real-world problems.
PLO4	Instil life-long learning and work in teams effectively, equip with moral values and professional ethics to take up responsibilities and reach out to societal needs.
PLO5	Undertake projects and research activities that enhance the technical skills that aid them to be successful IT Professionals.

Discrete Structures

Program Title	BCA
Course Title	Discrete Structures
Nature of Course	DSC
Semester	I
Total Hours	45
Credits	3

Objective:

To provide students a foundation in discrete mathematics on the topics such as set theory, logic, probability and graph theory and develop logical thinking and quantitative skills for continued success in Computer Science.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the basic principles of sets, operations on sets, relations and functions
CLO2	Acquire skills in mathematical reasoning techniques including induction and recursion
CLO3	Understand the concept of probability and probability distributions
CLO4	To apply graph and tree concepts in solving problems in Computer Science
CLO5	Create mathematical ideas to solve problems

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓	✓			
CLO2	✓	✓			
CLO3	✓	✓			
CLO4	✓	✓			
CLO5	✓	✓			

Course Content:

Module	Content	Hours
I	Set Theory and Logic Fundamentals of Set theory, Set Operations and the Laws of Set Theory, Counting and Venn Diagrams, Cartesian Products and Relations, Functions–One-to-One, Onto Functions, Function Composition and Inverse Functions. Mathematical Induction, The well ordering principle, Recursive Definitions, Structural Induction, Recursive algorithms. Fundamentals of Logic, Propositional Logic, Logical Connectives and Truth Tables, Logic Equivalence, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs. Proof Methods and strategy	10
II	Counting and Relations Basics of counting, Pigeonhole Principle, Permutation and Combinations, Binomial coefficients. Recurrence relations, Modeling with recurrence relations with examples of Fibonacci numbers and the tower of Hanoi problem. Divide and Conquer relations with examples (no theorems). Definition and types of relations, Representing relations using matrices and digraphs, Partial Orderings, Hasse diagrams, Maximal and Minimal elements, Lattices	10
III	Probability The Concept of Probability-Sample Spaces, Probability as Relative Frequency, Axiomatic Definition of Probability, Properties of Probability, Additive Property, Conditional Probability, Multiplicative Law of Probability, Law of Total Probability, Bayes' Formula, Independent Events.	7
IV	Probability Distributions Random Variables, Distribution Functions, Discrete Random Variables, Continuous Random Variables, Probability Mass Function and Probability Density Function, Expectation and Variance, Functions of Random Variables, Some important Probability Distributions: Discrete - Bernoulli Trials and Binomial distribution, Geometric distribution and Poisson distribution, Continuous - Uniform distribution, Normal distribution and Exponential distribution.	8
V	Graph Theory	10

	Graphs: Introduction, Representing Graphs, Graph Isomorphism, Operations on graphs. Trees: Introduction, Applications of Trees, Tree Traversal, Spanning Trees, Minimum Spanning Trees, Connectivity, Euler and Hamilton Paths, Planar Graphs. Directed graphs: Fundamentals of Digraphs, Computer Recognition - Zero-One Matrices and Directed Graphs, Out-degree, in-degree, connectivity, Eulerian and Hamilton directed graphs, tournaments.	
--	--	--

References:

1. Ralph P, Grimaldi: "Discrete and Combinatorial Mathematics", 5th Edition, Pearson Education, 2004.
2. C. L. Liu, "Elements of Discrete Mathematics", Tata McGraw-Hill, 2000.
3. Sheldon M Ross, "Introduction to Probability Models", 12th edition, Academic Press, 2019.
4. F. Harary, "Graph Theory", Addition Wesley, 1969.
5. Kenneth H Rosen, Discrete Mathematics and its Applications, McGraw Hill Publications, 7th Edition, 2007.
6. J. P. Tremblay and R.P. Manohar, "Discrete Mathematical Structures with applications to Computer Science", Mc Graw Hill Ed. Inc. 1975.
7. Sheldon M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 6 th Edition, Academic Press, 2020.
8. Michael Baron, "Probability and Statistics for Computer Scientists", 3rd Edition, CRC, 2019

Online Resources:

<https://www.my-mooc.com/en/categorie/mathematics>

<http://www.nptelvideos.in/2012/11/discrete-mathematical-structures.html>

<https://ocw.mit.edu/courses/mathematics/>

Teaching Pedagogy:

- **Structuring lessons:**
Teachers adopt pedagogies that foster communication and both individual and group responsibilities. Providing students with multiple opportunities within different contexts to practise skills and apply concepts allows them to consolidate and deepen their understanding.
- **Problem Solving:**
To make the students understand and have the knowledge about the concepts the problem solving technique is used. The students are motivated to solve the problem individually by allowing peer discussion.
- **Assignments and Quiz:**
Assignments and quiz are part of internal assessment. These are conducted to have an in depth knowledge of the subject.
- **Adaptive reasoning:**
Capacity for logical thought, reflection, explanation, and justification.
- **Productive disposition:**
Habitual inclusion to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy.

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Problem Solving Techniques Using 'C'

Program Title	Bachelor of Computer Applications (BCA)
Course Title	Problem Solving Techniques Using 'C'
Nature of Course	Discipline Specific Course
Semester	I
Total Hours	45
Credits	03

Objective:

To provide students with a robust foundation in algorithmic thinking and programming skills using the C language. Through a combination of theoretical instruction and practical exercises, aims to equip students with the ability to analyze problems, formulate efficient algorithms, and implement solutions using C programming, thereby preparing them for successful careers in the field of computer science and software development.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand various problem-solving techniques and design efficient algorithms to solve a given problem
CLO2	Analyze and Learn fundamental concepts of algorithm design and analysis process and asymptotic notations
CLO3	Evaluate the basic elements and the control structures of C programming and apply it to solve problems
CLO4	Apply debugging and testing skills for the data structures
CLO5	Create C programs incorporating functions, arrays, pointers and compile, debug, and execute the programs

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓	✓			
CLO2		✓	✓		
CLO3		✓			
CLO4	✓	✓			
CLO5					✓

Course Content:

Module	Content	Hours
I Fundamentals of Algorithms and Analysis	Introduction: The Role of Algorithms in Computing, Algorithms as a technology, Analyzing algorithms, Designing algorithms, Growth of Functions, Asymptotic notation, Standard notations and common functions. Fundamental Algorithms: Exchanging the values of two variables, Counting, Summation of a set of numbers,	08
II 'C' Language Fundamentals	Character set, constants, variables, expressions, keywords, data types, declaration, statements- types of statements -arithmetic, assignment, control, I/O statements, Operators in 'C', Hierarchy of operators. 'C' Program Constructs: Sequential, selective, repetitive controls. Multiway selection, break, continue, exit statements.	10
III Functions, Arrays and Pointers	Functions: Function definition, types of functions- built-in, user-defined, passing values between functions (call by value), Adding functions to the Library. Storage Classes. String functions: strlen, strcat, strcpy, strcmp and its variations. Arrays: Concepts, declaration, initialization, 1-D, 2-D arrays, passing arrays between functions. Multi-dimensional arrays. Pointers: Concept of pointers, address operator, pointer operator, pointer expression, pointer arithmetic, Pointers, and functions – call by reference. Operations on Bits: Bitwise operators.	10
IV	Structure: Declaration, initializing a structure, accessing structure elements, structure storage, array of structures, arrays within a structure, additional features and uses of	10

Structure, Union, Preprocessor & Input/Output	structures, functions and structures, nested structures, pointers and structures. Union: Union and bit fields, declarations, comparison between unions and structures typedef and sizeof operator & enumeration. Pre processor directives : Features, macros, file inclusion, conditional compilation Input/output: Types (Console & File), formatted & Un formatted, types of files, file operations-opening and closing a data file, creating and accessing a data file.	
V Factoring Methods	Factoring Methods: Finding the square root of a number, the smallest Divisor of an integer, the greatest common divisor of two integers, computing the prime factors of an integer, generation of pseudo random numbers.	7

References:

1. Steven S. Skiena, The Algorithm Design Module, Springer-Verlag London Ltd, 2nd Edition, 2008.
2. Donald E. Knuth, The Art of Computer Programming, Volume 1: Fundamental Algorithms, Addison Wesley Longman, 3rd Edition, 1997.
3. Donald E. Knuth, The Art of Computer Programming, Volume 2: Semi numerical Algorithms, Addison Wesley Longman, 3rd Edition, 1998.
4. Greg Perry and Dean Miller, C programming Absolute Beginner's Guide, Pearson Education, Inc, 3rd Edition, 2014.

Online Resources:

<https://www.javatpoint.com/>

<https://www.geeksforgeeks.org/>

Teaching Pedagogy:

- Lecture
- Quiz
- Encourage Algorithmic Thinking
- Testing and Debugging
- Practice with Exercises
- Continuous Assessment and Feedback

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Database Management Systems

Program Title	Bachelor of Computer Applications
Course Title	Database Management Systems
Nature of Course	Discipline Specific Course
Semester	I
Total Hours	45
Credits	3

Objective:

To efficiently store, retrieve, manage, and secure large volumes of data. It ensures data integrity, provides concurrent access for multiple users, and optimizes performance for faster data processing. Additionally, DBMS facilitates data backup and recovery, enabling reliable data management and maintenance.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand database concepts, data models and architecture
CLO2	Analyze a given database application scenario to use ER model for conceptual design of the database
CLO3	Understand relational algebra and normalize databases.
CLO4	Apply SQL queries to retrieve and manage databases
CLO5	Gain knowledge about indexing, transaction processing and concurrency techniques

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	√				
CLO2		√			
CLO3	√				
CLO4			√		
CLO5				√	

Course Content:

Module	Content	Hours
<p>I</p> <p>Database Concepts , Users and Architecture</p>	<p>Databases and Database Users: Introduction, An example, Characteristics of the Database Approach, Actors on the Scene, Workers behind the Scene, Advantages of Using DBMS Approach, A Brief History of Database Applications, When Not to Use a DBMS.</p> <p>Database System Concepts and Architecture: Data Models, Schemas, and Instances, Three-schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment, Centralized and Client-Server Architectures, Classification of Database Management Systems</p>	<p>8</p>
<p>II</p> <p>Data Modeling and Indexing Structures for Files</p>	<p>Data Modeling Using Entity-Relationship Model: Using High-Level Conceptual Data Models for Database Design, An Example Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design Company Database Diagrams, Naming Conventions and Design Issues.</p> <p>File organization and storage: secondary storage devices, type of single level ordered index, multi-level indexes, indexes on multiple keys, other types of indexes.</p>	<p>10</p>
<p>III</p> <p>Relational Data Model and Design</p>	<p>Relational Model and Relational Algebra: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations, Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from SET Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra. Relational Database Design: Anomalies in a database, functional</p>	<p>10</p>

	dependency, normal forms, lossless join and dependency, BCNF, normalization through synthesis, higher order normal forms.	
IV Structured Query Language	SQL:SQL Data Definition and Data Types, Specifying Constraints in SQL, Schema Change Statements in SQL, Basic Queries in SQL, More Complex SQL Queries, Insert, Delete and Update Statements in SQL, Specifying Constraints as Assertion and Trigger, Views (Virtual Tables) in SQL, Embedded SQL, Dynamic SQL	08
V Transaction Processing Concepts	Introduction to transaction processing: transaction and system concepts, desirable properties of transactions, transaction support in SQL. Concurrency control techniques: two-phase locking techniques, concurrency control based on timestamp ordering. Recovery techniques: recovery concepts, recovery in multi-database systems, database backup and recovery from catastrophic failures	09

Text Books

1. Elmasri and Navathe, "Fundamentals of Database Systems", 7th Edition, Addison - Wesley, 2016.
2. Silberschatz, Korth and Sudharshan, "Database System Concepts", 7th Edition, Tata McGraw Hill, 2019.

Reference Books

1. C.J. Date, A. Kannan, S. Swamynatham, " An Introduction to Database Systems", 8th Edition, Pearson education, 2009
2. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw- Hill, 2003

Online Resources:

<https://www.geeksforgeeks.org/dbms/>
<https://www.javatpoint.com/dbms-tutorial>

Teaching Pedagogy:

- Lectures and Demonstrations
- Interactive Discussions
- Lab Sessions
- Team Projects

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Data Structures

Program Title	Bachelor of Computer Application
Course Title	Data Structures
Nature of Course	Discipline Specific Course
Semester	II
Total Hours	45
Credits	3

Objective:

Mastering algorithm analysis and data structures, including their operations and implementations, to proficiently solve complex problems and optimize program efficiency. This entails understanding asymptotic notations, abstract data types, array and string manipulation, linked lists, stacks, queues, graphs, trees, search algorithms, sorting techniques, and their practical applications.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CL01	Understanding algorithm analysis and data structures is essential for efficient problem-solving, encompassing programming paradigms, asymptotic notations, and operations on structured data like arrays.
CL02	Analyse the fundamentals of arrays and strings, encompassing their representation, operations, and manipulation, while also examining linked lists, including their types, operations, and applications, to facilitate proficient data handling and algorithmic problem-solving.
CL03	Evaluate the application of graph theory and tree concepts in algorithmic problem-solving, demonstrating mastery through advanced manipulation of data structures at a heightened cognitive level.
CL04	Understand and apply searching techniques (linear, binary, and hashing)
CL05	Create a foundational understanding of search algorithms like linear, binary, and hashed searches, alongside sorting techniques including insertion, selection, quick, merge, and exchange sorts, both internal and external.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES

	PL01	PL02	PL03	PL04	PL05
CLO1	✓				
CLO2	✓	✓			
CLO3	✓	✓	✓	✓	
CLO4		✓	✓	✓	✓
CLO5		✓		✓	✓

Course Content:

Module	Content	Hours
I Introduction To Data Structures	Algorithm analysis: Knowledge of Programming and Problem solving techniques. Pseudo code, asymptotic notations (O, θ, Ω). Data Structures: Definition, Classification of Data Structures, Operations on Data Structure, Abstract Data Type, Array as Abstract Data Type.	5
II Linear Data Structures (Arrays & Lists)	Arrays: Definition, representation of arrays (row-major, column-major), operations on arrays, Types of arrays (1D, 2D, multi-dimensional), operations on arrays (insertion, deletion, traversal). String (Array of characters terminated by a null character). String operations - Character manipulation, String length, Concatenation, Sub string and Pattern Matching. Lists: Definition, Types of Linked List (Singly Linked List, Doubly Linked List, Circularly Linked List), Operations on Linked List (Insertion, Deletion, Search). Applications of Linked lists.	12
III Linear Data structures (Queues & Stack)	Stack: Definition, Primitive Operations (Push, Pop), Stack-implementation using Linked List. Applications of stacks (Function calls, recursion, infix to postfix expression, evaluation of postfix expression). Queues: Definition, Primitive Operations (Insertion, Deletion), Queue -Implementation Using Linked List, Double Ended Queue, priority queues, Garbage Collection. Applications of queues.	08

References:

1. Seymour Lipschultz - "Data structures with C ",Schaum's Series, McGraw-Hill Publications,2011.

<p style="text-align: center;">IV</p> <p>Non-Linear Data Structures</p>	<p>Graphs: Concepts, representation of graphs, applications of graphs, BFS & DFS traversal, Shortest path algorithm.</p> <p>Trees: Definition of Trees concept, Binary Tree -Definition with example, Linear and Linked List Representation of Binary Tree's , Expression trees. Binary search trees - concept, Operations - Creation, Insertion, Traversals.</p> <p>Height Balanced Trees – AVL trees, Multi way trees, B-trees, operations on B-tree.</p>	<p>15</p>
<p style="text-align: center;">V</p> <p>Searching & Sorting</p>	<p>Linear search, Binary search, hashed list searches. General sort concepts, external & internal sorting (insertion sort, selection sort, quick sort, merge sort, Exchange sort)</p>	<p>12</p>

2. Yashavant Kanetkar – “Data Structures through C” ,BPB Publications, Second Edition, 2010.

Text Books:

1. Seymour Lipschutz, “Data structures with C ”, Schaum’s Series, McGraw-Hill Publications, 2011.
2. Yashavant Kanetkar , “Data Structures through C” ,BPB Publications, Second Edition, 2010.
3. Robert Kruse, C.L.Tondo, Bruce Leung, Shashi Mogalla, “Data Structures and Program Design using C”, Pearson Education, 2009.

Online Resources:

<https://www.javatpoint.com/data-structure-tutorial>

https://www.tutorialspoint.com/data_structures_algorithms/index.htm

Teaching Pedagogy:

- Lectures
- Hands-on Coding Exercises
- Interactive Demonstrations
- Real-World Examples
- Group Discussion

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Assignment	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Object Oriented Programming using Java

Program Title	Bachelor of Computer Applications (BCA)
Course Title	Object Oriented Programming using Java
Nature of Course	Discipline Specific Core Course
Semester	II
Total Hours	45
Credits	3

Objective:

Develop proficiency in object-oriented programming principles through Java, integrating theoretical concepts with practical applications. Bridge theoretical knowledge with real-world scenarios, utilizing Java to create applications that model and interact with real-world entities. Foster a comprehensive understanding of object-oriented programming by engaging in hands-on projects that demonstrate the relevance and applicability of Java in various domains.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand object oriented principles and analyse language fundamentals in addition to define classes, objects and invoking methods
CLO2	Apply the fundamental concepts of Inheritance, Polymorphism, and Interfaces, and demonstrate proficiency in their use to solve problems
CLO3	Interpret and implement multithreaded applications, and evaluate input/output (I/O) functionality to design efficient and responsive software systems.
CLO4	Design and develop applications with Graphical User Interfaces (GUIs), integrating user-friendly interfaces into software solutions effectively.
CLO5	Create Java Beans and demonstrate the ability to implement network-based applications, integrating networking functionality seamlessly into software solutions

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓				
CLO2		✓			
CLO3			✓		
CLO4				✓	
CLO5					✓

Course Content:

Object Oriented Programming using Java		
Module	Description	Hours
I Introduction to Java	Overview of Java: Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java. Objects and Classes: Basics of objects and classes in java, this keyword, Constructors, Constructor Overloading, finalize() method, Visibility modifiers, Methods and objects, Inner Class, String class, String Buffer.	10
II Inheritance, Polymorphism, Interfaces, Packages and Exception Handling	Inheritance: Inheritance in java, Super and sub class, Overriding, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class. Interfaces and Packages: Interfaces, Packages, UTIL package. Exception Handling: Exception handling with try-catch-finally.	10
III I/O Programming and Multithreading in Java	Multithreaded Programming: Thread life cycle and methods, Runnable interface, Thread synchronization. I/O Programming: Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files.	8
IV Event Handling using Swing and GUI programming	Applet Programming: Applet and its life cycle. Event Handling: Event handling mechanism, Event types, Mouse and key events. Swing: Introduction to swing, Exploring Swing Components, Collections in Java Graphics Programming: GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI	12

	components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box.	
V Java Beans and Java Network Programming.	Java Beans: Introduction to Java Beans, Developing a Simple Bean. Java Network Programming: Introduction, Networking Basics.	5

Text Book

1. E. Balagurusamy, "Programming with JAVA", McGraw Hill, New Delhi, 2007

Reference Books

1. Raj Kumar Buyya, "Object Oriented Programming with JAVA", McGraw Hill, 2009
2. Herbert Schildt, "Java A Beginner's Guide – Create, Compile, and Run Java Programs Today" Sixth Edition, Oracle Press, 2014
3. Ken Arnold, James Gosling, "The Java Programming Language", Fourth Edition, Addison Wisely, 2005
4. Herbert Schildt, "The Complete Reference Java", 7th Edition, McGraw Hill, 2007.

Online Resources

<https://docs.oracle.com/javase/tutorial/>

<https://javabeginnerstutorial.com/core-java-tutorial/>

Teaching Pedagogy:

- Case studies
- Presentations on topics related to Java programming

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Computer Organization

Program Title	BCA
Course Title	Computer Organization
Nature of Course	Discipline Specific Course
Semester	II
Total Hours	45
Credits	3

Objective:

To understand the basic model of a computer on processor design in which data representation and instruction basics, design of an ALU and the concepts of memory design are discussed.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the Number Systems and basic structure of a computer.
CLO2	Analyze the design of combinational circuits and delve into understanding instruction codes, timing signals, and control signals.
CLO3	Evaluate the stack organization and addressing modes within CPU architecture.
CLO4	Apply knowledge of interrupts and direct memory access within input-output organization.
CLO5	Create an understanding of memory organization and its underlying purpose.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓				
CLO2	✓	✓			✓
CLO3	✓	✓			
CLO4	✓	✓	✓		✓
CLO5	✓	✓			

Course Content:

Module	Content	Hours
I Number Systems, Computer Arithmetic, Structure of Computers	Number Systems: Binary, Octal, Hexadecimal numbers, base conversion, addition, subtraction of binary numbers, one's and two's complements, positive and negative numbers, character codes ASCII, EBCDIC. Computer Arithmetic: Addition and Subtraction, Multiplication and Division algorithms, Floating-point Arithmetic Operations, Decimal arithmetic operations. Structure of Computers: Computer types, Functional units, Basic operational concepts, Von-Neumann Architecture, Bus Structures, Software, Performance, Multiprocessors and Multicomputer.	8
II Basic Computer Organization and Design	Digital Logic Circuits: Logic gates, Boolean algebra, Map simplification. Combinational Circuits - Half Adder, Full Adder, Flip Flops. Sequential circuits - Shift registers, Counters, Integrated Circuits, Mux, Demux, Encoder, Decoder. Data representation: Fixed and Floating point. Basic Computer Organization and Design: Instruction codes, Computer Registers, Computer Instructions and Instruction cycle. Timing and Control, Memory-Reference Instructions, Input-Output and interrupt.	12
III CPU Organization, Register Transfer and Micro-operations	Central processing unit: Stack organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC. Register Transfer and Micro-operations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-	10
	Operations, Shift Micro-Operations, Arithmetic logic shift unit.	

<p style="text-align: center;">IV Micro- Programmed control</p>	<p>Micro-programmed Control: Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit. Input Output: I/O interface, Programmed IO, Memory Mapped IO, Interrupt Driven IO, DMA. Instruction level parallelism: Instruction level parallelism (ILP)-over coming data hazards, limitations of ILP</p>	<p style="text-align: center;">10</p>
<p style="text-align: center;">V Memory System and Multiprocessors</p>	<p>Memory System: Memory Hierarchy, Semiconductor Memories, RAM (Random Access Memory), Read Only Memory (ROM), Types of ROM, Cache Memory, Performance considerations, Virtual memory, Paging, Secondary Storage, RAID. Multiprocessors And Thread Level Parallelism: Characteristics of multiprocessors, Multi-Threaded Architecture, Distributed Memory MIMD Architectures, Interconnection structures,</p>	<p style="text-align: center;">5</p>

References:

1. M. Moris Mano, "Computer System, Architecture", Prentice Hall, India, 2nd Edition. 2. Kai Hwang ,ZhiweiXu " Scalable Parallel Computing Technology, Architecture, Programming" McGraw-Hill Publications(Unit IV- Pipelining)
2. Subrata Ghoshal, "Computer Architecture And Organization", Pearson India(2011).
3. Andrew S. Tanenbaum, " Structured Computer Organization", Pearson , 5th Edition, Education Inc(2006).
4. Carl Hamacher, Zvonks Vranesic,SafeaZaky, "Computer Architecture And Organization", McGraw Hill New Delhi, 5th Edition, India(2002)
5. Kai Hwang, "Advanced Computer Architecture - Parallelism, Scalability, Programmability",Tata Mcgraw-Hill (2008).

Online Resources:

<https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/?ref=lbp>

Teaching Pedagogy:

- Lecturing
- Illustrations
- Problem-solving
- Classwork

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Operating Systems

Program Title	Bachelor of Computer Applications (BCA)
Course Title	Operating Systems
Nature of Course	Discipline Specific Course
Semester	III
Total Hours	45
Credits	3

Objective

Gain comprehensive insight into the operations of an operating system, focusing on its vital function in orchestrating diverse computer resources. Explore the intricate mechanisms through which operating systems manage hardware, software, and user interactions. Delve into the core functionalities of operating systems, elucidating their pivotal role in optimizing system performance and facilitating seamless user experiences. Develop a deep understanding of how operating systems regulate processes, memory, storage, and other resources, essential for effective computing environments.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the structure and functionalities of an Operating System and analyze the concept of processes to discern their role in system operation.
CLO2	Analyze CPU Scheduling algorithms to evaluate their effectiveness in managing system resources and optimizing system performance.
CLO3	Evaluate different memory management techniques to determine their suitability for managing system memory efficiently.
CLO4	Assess different disk space allocation methods and free space management techniques to optimize disk utilization and improve system performance.
CLO5	Create Case Studies of Linux and Windows Operating Systems to compare and contrast their design principles, features, and functionalities for real-world application.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PL01	PL02	PL03	PL04	PL05
CLO1	✓				
CLO2		✓			
CLO3			✓		
CLO4				✓	
CLO5					✓

Course content:

Operating System		
Module	Description	Hours
I Operating System Overview and System Structures	Introduction : Introduction to Operating Systems, Evolution of Operating Systems, Types of Operating Systems: Early Systems, Multi-programming, Time-Sharing, Distributed Systems and Real-time Systems. Operating System Structures, System components, Operating system Services, System Calls, System programs.	8
II Process Management	Process Concept: Process States, Process Control Block, Process Scheduling, Interprocess Communication. Process Scheduling: Scheduling Criteria, CPU Scheduling, CPU Scheduling Algorithms, Algorithm Evaluation. Process Synchronization & Deadlocks: Critical-Section Problems- Producer Consumers Problem, Readers and Writers Problem, Dining Philosophers Problem. Semaphores, Monitors, Deadlock characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Recovery from Deadlock.	10
III Memory Management	Memory Management Strategies: Main Memory Management Basic Concepts, Logical and Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation. Virtual memory: Demand Paging, Page Replacement, Page Replacement Algorithms, Thrashing.	10

IV Storage Management	File System: File System Organization, File Operations, File Accessing Methods, Directory Structures, File Protection, Allocation Methods, Free- Space Management. Secondary Storage Structure: Disk structure, Disk Scheduling, Algorithms, Disk management, Swap-Space Management.	7
V Protection and Security	System Protection: Goals of Protection, Principles of Protection, Access Matrix. System Security: Security Problem, Program Threats, User Authentication, Firewalling to Protect System and Networks Case Study : Unix & Windows	10

Text Books

1. Silberschatz Galvin Gagne – “Operating system concepts”, New Delhi: Wiley India Pvt Ltd.,Eighth Edition, 2012.
2. William Stallings- “Operating Systems –Internals and Design Principles”- Pearson Education,Fifth Edition, 2009

Reference Books

1. Milan Milankovic – “Operating systems concepts and design” –Tata McGraw Hill Publications,Second Edition 1992.
2. Dietel and Dietel- ”Operating System” - Pearson Education, Third Edition, 2004.
3. Tanenbaum, S Andrew, Operating Systems – Design and Implementation, PHI, 2001.

Online Resources

<https://www.javatpoint.com/operating-system>

Teaching Pedagogy:

- Explore about different OS available.
- Presentations on topic related to operating systems

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Computer Networks

Program Title	BCA
Course Title	Computer Networks
Nature of Course	Discipline Specific Course
Semester	III
Total Hours	45
Credits	3

Objective:

Acquire foundational knowledge in computer networking encompassing principles, protocols, architectural concepts, and practical applications. Explore the intricate workings of network protocols, delving into their roles in facilitating communication between devices. Understand the architecture of computer networks, discerning how various components interconnect to enable data transmission. Apply theoretical insights to real-world scenarios, honing skills in configuring, troubleshooting, and optimizing network environments.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand basic concepts of networks, network hardware and network software and describe various standard network reference models
CLO2	Analyze data communication principles, explore different transmission media, and become acquainted with modulation, multiplexing, and switching techniques.
CLO3	Evaluate error detection and correction mechanisms, data link protocols, and grasp the significance of the medium access control sub-layer.
CLO4	Apply routing and congestion management techniques in network design, and conduct analysis of their effectiveness.
CLO5	Create a foundation in network security, DNS, email protocols, and encryption algorithms.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PL01	PL02	PL03	PL04	PL05
CLO1	✓		✓		✓
CLO2	✓	✓	✓		
CLO3	✓	✓			✓
CLO4	✓	✓	✓		✓
CLO5	✓		✓		✓

Course Content:

Module	Content	Hours
I Introduction	Uses of Computer Networks: Networks for companies, networks for people, Social issues. Network Hardware: Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Wireless networks, Internetworks. Network Software: Protocol Hierarchies, Design Issues for the Layers, Interfaces and services, Connection-Oriented Versus Connectionless Service. Reference Models: The OSI Reference Model, The TCP/IP Reference Model, A Comparison of the OSI and TCP/IP Reference Models.	8
II Physical Layer	The Theoretical Basis for Data Communication: Fourier Analysis, Bandwidth-Limited Signals, The Maximum Data Rate of a Channel. Transmission Media: Guided transmission media, wireless transmission, Communication satellites. Digital Modulation And Multiplexing: Baseband Transmission, Passband Transmission, Frequency Division Multiplexing, Time Division Multiplexing. The Telephone System :Switching.	10

<p style="text-align: center;">III MAC Sub Layer and Data Link Layer</p>	<p>Data Link Layer Design Issues: Services Provided to the Network Layer, Framing, Error Control, Flow Control.</p> <p>Error Detection And Correction: Error-Correcting Codes, Error-Detecting Codes. Elementary Data Link Protocols : A Simplex Stop-and-Wait Protocol for a Noisy Channel.</p> <p>Sliding Window Protocols: A One-Bit Sliding Window Protocol, A Protocol Using Go-Back-N, A Protocol Using Selective Repeat. MAC Sub Layer : The Channel Allocation Problem: Static and dynamic Channel Allocation. Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, Collision-Free Protocols.</p> <p>IEEE standard 802 For LANS And MANS: Ethernet, 802.4 – Token Bus, 802.5 – Token Ring) Working and frame formats.</p>	12
<p style="text-align: center;">IV Network Layer and Transport Layer</p>	<p>Network Layer Design Issues: Store-and-Forward Packet Switching, Services Provided to the Transport Layer, Implementation of Connectionless Service, Implementation of Connection-Oriented Service, Comparison of Virtual-Circuit and Datagram Networks. Routing Algorithms: The Optimality Principle, Shortest Path Algorithm, Flooding.</p> <p>Congestion Control Algorithms : Approaches to Congestion Control, Traffic Shaping. The Network Layer In The Internet : The IP Version 4 Protocol, IP Addresses, IP Version 6.</p> <p>Transport Layer: Elements of Transport protocols: Addressing, Connection Establishment, Connection Release, Error Control and Flow Control.</p>	8
<p style="text-align: center;">V Application Layer</p>	<p>Network Security: Traditional Cryptography, Digital Signatures, DES,AES Domain Name System: The DNS Name Space, Domain Resource Records, Name Servers. Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer. Communication Security: Firewalls.</p>	7

References:

1. Andrew S Tanenbaum – – Computer Networks|| – PHI ,Fifth Edition, 2011.
2. William Stallings – – Data and Computer Communications|| – Pearson Education Asia, Seventh Edition,2001
3. Douglas E Comer - –Computer Networks and Internets||, -Pearson Education, 2014.
4. Larry L. Peterson, Bruce S Davie – –Computer Networks: A Systems Approach||, Fourth Edition,2007 (The Morgan Kaufmann Series in Networking)

Online Resource:

<https://www.geeksforgeeks.org/computer-network-tutorials/?ref=lbp>

<https://www.javatpoint.com/computer-network-tutorial>

Teaching Pedagogy:

- Lecturing
- Illustrations
- Simulation
- Assignment

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Python Programming

Program Title	BCA
Course Title	Python Programming
Nature of Course	Discipline Specific Course
Semester	III
Total Hours	45
Credits	3

Objective:

Develop proficiency in Python scripting by mastering advanced features such as object-oriented programming, libraries, and modules. Utilize these skills to create efficient and scalable software solutions tailored to various application domains. Gain expertise in leveraging Python's versatility for diverse programming tasks through hands-on exploration and practice.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand various data types and packages in Python
CLO2	Analyzing the operations of creating, accessing, counting, and manipulating elements in lists, tuples, and dictionaries, including slicing, adding, deleting, searching, and iterating through elements, to understand their respective data structures and usage patterns thoroughly.
CLO3	Evaluate Python file handling techniques, including opening, reading, writing, appending, and manipulating files, to ensure efficient file management in Python programs.
CLO4	Apply function definition, invocation, and Python string manipulation alongside module management to enhance code modularity and reusability.
CLO5	Create a comprehensive understanding of OOP principles, inheritance, exceptions, Python libraries, and GUI-based data processing in Python programming.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓				
CLO2	✓	✓			
CLO3	✓	✓	✓	✓	
CLO4		✓	✓	✓	✓
CLO5					✓

Course Content:

Module	Content	Hours
I Python Basics, Control Structures & Other Features	Python Basics: History of Python, Features of Python, Basic Data Types, Identifiers, Keywords, Variables, Built-in Data Types, Input and Output Statements, Indentation, Expressions, Type conversions. Python Arrays: Defining and Processing Arrays, Array methods. Control Structures: Selection/Conditional Branching statements- if, if-else, nested if and if-elif-else statements. Iterative Statements- While loop, for loop, else suite in loop and nested loops. Jump Statements: break, continue and pass statements	10
II Lists, Tuples and Dictionaries	Lists: Creating, Accessing & Counting List elements, List Slices, Adding and Deleting elements Tuples: Creating Tuples, Accessing, Counting and Iterating through tuple elements, Searching elements, Tuple Slices. Dictionaries: Creating Dictionaries, Accessing, Counting and Iterating through dictionary elements, Searching elements.	8
III Python File Handling Reading and Writing files	Python File Handling: Types of files in Python, Opening and Closing files. Reading and Writing files: write() and writelines() methods, append() method, read() and readlines() methods, with keyword, splitting words, File methods, File Positions, Renaming and Deleting files	9

IV Functions, Python Strings & Modules	Functions: Definition, Function Call, Positional Arguments, Default, Keyword and Variable Arguments, Returning from Functions, Returning Single Values and Collections from Functions. Python Strings: Search, Split, Join, Modify, Replace operations Modules: import statement-The Python module-dir() function, Modules and Namespace, Defining our own modules.	9
V Object Oriented Programmi ng in Python	OOP in Python: Overview of OOP Principles, Defining class, Instantiating class, Instance Variables and Class Variables, Constructors and Destructors, Private, Public and Protected members Simple Inheritance, Function Overriding, Multiple Inheritance, Polymorphism. Exceptions, Python Libraries. Data processing with GUI.	9

Text Books:

1. B. Nagesh Rao, " Learning Python", CyberPlus Infotech Pvt.Ltd, 2017
2. Reema Thareja, "Python using problem solving approach", First Edition 2017, Oxford University press
3. Dr.R. Nageswara Rao, "Core Python Programming", First Edition, 2017, Dreamteh Publisheres

References:

1. Allen B. Downey, "Think Python", O' ReillyMedia Inc; 2016
2. Matic C.Brown, "The Complete Reference Python",M.C.Graw HillEducation, 2001.
3. Alan D. Moore & B. M. Harwani," Python GUI Programming - A Complete Reference Guide", Packt Publishing Ltd,2019
4. Burkhard A, Meier "Python GUI Programming Cookbook" Packt Publishing Ltd,2015

Online Resources:

<https://www.python.org/doc/>

<https://realpython.com/>

Teaching Pedagogy:

- Hands-on Coding
- Project-based Learning
- Peer Learning and Collaboration
- Interactive Learning Resources

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Assignment	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Open Source Tools

Program Title	BCA
Course Title	Open Source Tools
Nature of Course	Skill Enhancement Course
Semester	III
Total Hours	30
Credits	2

Objective of the Course:

The objective of open-source tools is to provide accessible, collaborative, and transparent software solutions. These tools empower users to modify, distribute, and enhance software according to their needs, fostering innovation and community-driven development. By promoting inclusivity and transparency, open-source tools democratize technology and enable cost-effective solutions for individuals, organizations, and communities worldwide.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the fundamental concepts of Open Source Technology.
CLO2	Identify and use appropriate open source tools based on the nature of problem.
CLO3	Understanding the benefits, challenges, and implications for technology, society, and the economy of Apache, Berkeley Software Distribution, Mozilla (Firefox), Wikipedia, Joomla, GNU Compiler Collection, Libre Office

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓				
CLO2	✓		✓		✓
CLO3	✓			✓	✓

Course Content:

Module	Content	Hours
I Introduction to Open Source Softwares	Introduction to Open sources, Need of Open Sources, Open Source –Principles, Standard Requirements, Advantages of Open Sources – Free Software – FOSS Licenses – GPL, LGPL, Copyrights, Patents, Contracts & Licenses and Related Issues Application of Open Sources. Open Source Operating Systems : FEDORA, UBUNTU	12
II Programming Tools And Techniques	Usage of design Tools like Argo UML or equivalent ,Version Control Systems like Git or equivalent ,Bug Tracking Systems (Trac, BugZilla) , BootStrap	10
III Case Studies	Apache, Berkeley Software Distribution, Mozilla (Firefox),Wikipedia Joomla,GNU Compiler Collection, Libre Office	08

Text Book:

1. KailashVadera, Bhavyesh Gandhi, “Open Source Technology”, Laxmi Publications Pvt. Ltd 2012, 1st Edition.

Reference Book :

1. Fadi P. Deek and James A. M. McHugh, “Open Source: Technology and Policy”, Cambridge Universities Press 2007.

Online Resources:

<https://opensource.com/resources/what-open-source>

<https://www.studysmarter.co.uk/explanations/computer-science/computer-programming/programming-tools/>

Teaching Pedagogy:

- Lectures
- Tutorials
- Practical's/Projects

Evaluation Pattern:

Continuous Internal Assessment	Seminar/Presentation Project	25 marks
Semester End Examination	SEE	25 marks
TOTAL		50 marks

Software Engineering

Program Title	Bachelor of Computer Applications
Course Title	Software Engineering
Nature of Course	Discipline Specific course
Semester	IV
Total Hours	45
Credits	3

Objective of the Course:

To elevate students' proficiency in software engineering principles through comprehensive instruction. This approach covers a wide range of learning activities and aims to promote critical thinking skills necessary for effectively managing and designing software projects. To tackle real-world challenges in the dynamic field of software engineering.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand basic concepts of software engineering and Compare different software engineering process models.
CLO2	Analyze the principles of requirement Engineering and modeling.
CLO3	Evaluate software quality assurance methodologies and practices.
CLO4	Apply different testing techniques.
CLO5	Create proficiency in utilizing techniques and tools for designing a given project.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓				
CLO2	✓	✓			✓
CLO3			✓		✓
CLO4		✓	✓		
CLO5				✓	✓

Course Content:

Module	Content	Hours
I Introduction to Software Process	Introduction: Defining software, Characteristics of software, Software Application domains, Legacy software, Software Engineering – Layers, Software process, Software engineering practice – Essence of practice and Software Myths Software Process: Process Models, Software Process Framework – Defining a framework activity, Prescriptive Process Models – The Waterfall Model, Incremental Process Models, Evolutionary Process Models – Prototyping, Spiral Model, Concurrent models, Agile Model.	8
II Requirements for Software Engineering	Understanding Requirements: Requirements Engineering, Establishing the groundwork – Identifying Stakeholders, Recognizing multiple viewpoints, Working toward Collaboration, Asking the first questions-,Eliciting requirements, Developing Use Cases, Building Requirement Model-Elements of Requirement Model, Analysis Pattern , Negotiating and Validating Requirements.	7
III Software Design Concepts	Design Process: Software Quality guidelines and attributes, Evolution of Software Design, Design Concepts – Abstraction, Architecture, Patterns, Separation of concerns, Modularity, information hiding, Functional Independence, refinement, Aspects, Refactoring. The Design Model – Data Design elements, Architectural Design elements, Interface Design Elements, Component-Level Design elements. Architectural Design - Defining Architecture and patterns, Component level design – Coupling.	10
IV Software Quality and Testing Concepts	Quality Management: Defining quality, Software Quality, Achieving Software Quality, Defect amplification model, Formal Technical reviews, SQA – elements of SQA, SQA- Tasks, Goals and Metrics, Software Reliability, SQA Plan. Software Testing Strategies: Strategic Approach to Software Testing, Test strategies for Conventional Software – Unit testing, Integration testing, Validation testing, System testing, Software testing fundamentals, White-Box testing, Basic path testing, Control structure testing and Black- box testing.	10
V Software Project	Project Management Concepts: Management Spectrum, Product, Process, Project – signs,W5HH Principle, Metrics in process and project domains, Software Measurement, Metrics for Software	10

Management	Quality, Project Planning process, software project estimation Decomposition Techniques. Estimation Models- COCOMO Model. Risk Management: Risk Identification, Risk Projection and RMMM Plan	
------------	--	--

References:

1. Pressman S Roger, –Software Engineering A Practitioner_s Approach”, McGraw Hill, International Editions, 7th Edition, 2010.
2. Rajib Mall, –Fundamentals of Software Engineering||, PHI Learning Pvt. Ltd, Fourth Edition, 2014
3. Pankaj Jalote,||An Integrated approach to Software Engineering||, Narosa Publishing House, Third Edition,2013.

Online Resources:

<https://www.geeksforgeeks.org/software-engineering/>

<https://www.javatpoint.com/software-engineering>

Teaching Pedagogy:

- Quiz
- Group Discussion
- Hands-on Projects
- Practical Examples and Case Studies

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Artificial Intelligence

Program Title	Bachelor of Computer Applications
Course Title	Artificial Intelligence
Nature of Course	Discipline Specific course
Semester	IV
Total Hours	45
Credits	3

Objective:

Gain a foundational understanding of AI, encompassing learning, natural language processing, agents and robotics, expert systems, and planning, to foster comprehensive knowledge and skills in this field.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand basic concepts of software engineering and Compare different software engineering process models.
CLO2	Analyze methods of representing facts and knowledge to effectively capture and utilize information in AI systems.
CLO3	Evaluate the syntax, semantics, and pragmatics of statements written in natural language.
CLO4	Apply knowledge of agent structure and functions to improve the performance of intelligent agents in AI systems
CLO5	Create Expert systems architecture and implement knowledge acquisition and validation processes.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓	✓			
CLO2	✓	✓	✓		
CLO3			✓		
CLO4				✓	
CLO5					✓

Course Content:

Artificial Intelligence		
Module	Description	Hours
I Introduction	Introduction: The AI Problems, The Underlying Assumption, The Level of the Model, Criteria for Success. Problems, Problem Spaces and Search- Defining the problem as a State Space Search, Production Systems, Problem Characteristics.	8
II Search Techniques	Heuristic Search Techniques: Generate-and-test, Hill Climbing, Best First Search- Problem Reduction - AND-OR Graphs, A* and AO* Algorithm, Constraint Satisfaction, means-ends analysis, Game Playing- Min-Max, Alpha beta cutoffs.	10
III Knowledge Representation	Knowledge Representation: Knowledge Representation issues- Representations and mappings, Approaches to Knowledge Representation and issues. Using Predicate Logic- Representing Simple Facts in Logic, Representing Instance and Isa Relationships, Computable Functions and Predicates. Representing Knowledge Using Rules- Procedural versus Declarative Knowledge, Forward versus Backward Reasoning, Control Knowledge.	10
IV Planning, Learning & Natural Language Processing	Planning: Overview- An Example Domain: The Blocks World- Components of a Planning System - Goal Stack Planning. Learning: Introduction- Rote Learning, Learning by taking advice, Explanation based Learning. Natural Language Processing: Introduction- Overview of Linguistics, Grammars and Languages, Parsing Techniques, Semantic analysis and Representation Structures, Natural Language Generation.	10
V Expert Systems	Expert Systems: Introduction, Characteristic features of Expert System, Applications, Importance of Expert System. Rule-based System Architectures, Non Production System Architectures- Associative Network, Frame, Decision Tree- Blackboard System, Neural Network Architectures, Dealing with Uncertainty.	7

Text Books

1. Elaine Rich, Kevin Knight, Shivashankar B Nair, "Artificial Intelligence", Tata McGraw Hill Publications, Third Edition, 2013

2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert System, Prentice Hall of India, 1992

Reference Books

1. Jean-Louis Ermine, "Expert Systems : Theory and Practice", Prentice Hall of India, 1995

2. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach , Prentice Hall. Third Edition.

Teaching Pedagogy:

- Mini Project
- Presentations on topic related to Artificial Intelligence

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Internet Technologies

Program Title	Bachelor of Computer Applications
Course Title	Internet Technologies
Nature of Course	Discipline Specific Course
Semester	IV
Total Hours	45
Credits	3

Objective:

Developing skills to create dynamic web pages empowers you to harness the full potential of the web as a medium of communication. Whether you're building a personal blog, an e-commerce website, a corporate intranet, or a social networking platform, proficiency in web development enables you to create engaging, interactive, and impactful digital experiences for your audience.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the elements of HTML and design static web pages
CLO2	Develop interactive web pages using JavaScript and dynamic HTML
CLO3	Develop interactive web pages using JQuery and JSON
CLO4	Learn basics of JSP and apply it to develop dynamic websites
CLO5	Apply the skill in integrating MySQL databases with web applications

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	√	√			
CLO2		√			
CLO3		√			

CLO4	√		√		
CLO5			√		√

Course Content:

Module	Content	Hours
I Introduction to Internet	Introduction to Internet: History of Internet, Models Of Internet, Internet Protocols, Internet Standards: Standards bodies and the standards process, Levels of Internet Connectivity, Addressing in Internet: Domain Name System, Services on Internet: E-mail, WWW, Telnet, FTP, IRC and Search Engine, Current Trends on Internet	8
II Introduction to HTML, Bootstrap	HTML: Introducing HTML and XHTML, Basic text formatting, Presentational elements, Phrase elements, Lists, Editing text, Using Character entities for special characters, Links and Navigation, Images, Audio and Video, Tables, Forms, Frames. Bootstrap: Introducing Bootstrap, Working with Layouts – working with containers, inserting rows and columns to layout, Working with Content – Headings, Paragraphs, Lists, Coding Tables, Images, badges, Typography, Colors, Alerts, Jumbotron, Forms, Form inputs, Components – Button, Button groups, Checkbox and Radio buttons, nav bar, Progress bar, Pagination and breadcrumbs	12
III Java Script	Java Script: Introduction to Java script, Features of Java Script, Including Java Script in HTML file, Simple Examples, Java Script Data types, Java Script Operators, Java Script Decision statements, Java Script Looping Structures , Functions, Events, Strings ,String Methods ,Arrays and Array Methods, Communicating with user – alert(), prompt(), confirm() methods, Function, Creating Interactive forms, Working with form elements.	10
IV jQuery & JSP	JQuery: Introduction to JQuery Syntax, JQuery Selectors, JQuery Events-Mouse, Document, Forms and Keyboard, JQuery Effects, JQuery get and set attributes. Java Servlet Programming: Introduction to JSP, Lifecycle of JSP,JSP Architecture, JSP scripting elements, JSP directives, JSP Actions, JSP Expression, JSP declaration, JSP implicit objects, JSP Session, JSP Exception. CRUD in JSP	10
V MySQL & AJAX	MySQL: Naming Database Elements, Choosing Column Types sand Properties, and Accessing MySQL. AJAX: The Basics, Ajax the Query way – load, get and post, JSON –Accessing JSON data.	5

Text Books

1. Deitel & Deitel ,“Internet & World Wide Web –How to Program”, Pearson Education, Fourth Edition, 2009.
2. Jon Duckett, “ Beginning HTML, XHTML, CSS and JavaScript”, Wiley Publications, 2012.
3. Faithe Wempen, HTML 5 Step by Step, Microsoft Press, PHI, 2012.
4. Matt Lambert, “Learning Bootstrap 4”, Second Edition, Packt Publishing, 2016
5. [2] David Sawyer McFarland, “Javascript& jQuery – The Missing Manual”, O Reilly,2011.

Reference Books

1. Dr.Ravinder Singh, Amit Gupta, “Magic with HTML, DHTML and Javascript”, Laxmi Publications, First Edition, 2009.
2. Herbert Schildt, “C# 4.0 : The Complete Reference”, Tata McGraw Hill ,2010.
3. MacDonald , “The Complete Reference ASP.NET ”, Tata McGraw Hill,2002 .
4. Matt Doyle, “Beginning PHP 5.3”, Wiley Publishing, 2010

Online Resources:

<https://www.w3schools.com/html/>
<https://www.w3schools.com/bootstrap/>
<https://www.w3schools.com/js/>
<https://www.w3schools.com/jquery/default.asp>

Teaching Pedagogy:

- Lectures and Demonstrations
- Interactive Discussions
- Lab Sessions
- Team Projects
- Review of Research Papers

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Design and Analysis of Algorithms

Program Title	Bachelor of Computer Applications (BCA)
Course Title	Design and Analysis of Algorithms
Nature of Course	Discipline Specific Course
Semester	V
Total Hours	60
Credits	4

Objective:

The course aims to familiarize students with various algorithmic paradigms, Analyze the efficiency of algorithms, aiding them in making informed decisions about algorithm selection and design. Exposure to a wide range of algorithmic problems, to develop problem-solving abilities, learn how to break down complex problems into smaller, more manageable subproblems and apply appropriate algorithmic techniques to solve them systematically and efficiently.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand fundamental concepts of algorithm design and analysis process
CLO2	Apply algorithm design techniques to various problems and analyse efficiency of various algorithms
CLO3	Apply algorithm design techniques to graph applications and evaluate their efficiency
CLO4	Understand and apply Back tracking and Branch and bound techniques to real time applications
CLO5	Understand the fundamental concepts of P, NP and NP-Complete problems

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	√	√			
CLO2	√	√	√		
CLO3	√	√	√		
CLO4	√	√	√		
CLO5	√	√			

Course Content:

Module	Content	Hours
I Fundamentals of Algorithm	Introduction: Algorithms, Fundamentals of Algorithmic Problem Solving, Important Problem Types, Fundamental Data Structures. Fundamentals of the Analysis of Algorithm Efficiency: The Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms, Empirical Analysis of Algorithms	10
II Algorithm Design Techniques	Brute Force Method: Selection Sort and Bubble Sort, Sequential Search, Brute-Force String Matching, Exhaustive Search, Depth-First Search and Breadth-First Search. Decrease and Conquer: Insertion Sort, Decrease by-a-Constant-Factor Algorithms. Divide and Conquer: Merge Sort, Quick Sort, Binary Tree Traversals and Related Properties, Strassen's Matrix Multiplication.	15
III Space and Time Tradeoffs & Dynamic Programming	Space and Time Tradeoffs: Sorting by Counting, Input Enhancement in String Matching, Hashing. Dynamic programming: Binomial Coefficient, Principle of Optimality, Optimal Binary Search Trees, Knapsack Problem and Memory Functions	12

IV Greedy Technique	Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees.	12
V Limitations of Algorithm Power, Back Tracking & Branch-and- Bound	Limitations of Algorithm Power: Lower-Bound Arguments, Decision Trees, P, NP and NP Complete Problems .Coping with the Limitations of Algorithm Power: Back Tracking: n Queens problem, Hamiltonian Circuit Problem, Subset-Sum Problem. Branch-and-Bound: Assignment Problem, Traveling Salesman Problem	11

Text Books

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson, 2012.
2. Horowitz, Sahni, Rajasekaran, "Fundamentals of Computer Algorithms", 2/e, Universities Press, 2007.

Reference Books

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, The MIT Press, 2009.
2. A.V. Aho, J.E. Hopcroft, J.D. Ullmann, "The design and analysis of Computer Algorithms", Addison Wesley Boston, 1983.
2. Jon Kleinberg, Eva Tardos, "Algorithm Design", Pearson Education, 2006.

Online Resources:

- <https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/>
- <https://www.javatpoint.com/daa-tutorial>

Teaching Pedagogy:

Lectures, Problem-solving and Practice sessions, Assignments in advanced algorithm techniques and research paper review on current algorithm applications, Assessment through tests and presentations. Remedial sessions to help slow learners.

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Data Warehousing and Data Mining

Program Title	Bachelor of Computer Applications
Course Title	Data Warehousing and Data Mining
Nature of Course	Discipline Specific Course
Semester	V
Total Hours	60
Credits	4

Objective:

To elucidate the comprehensive architecture of data warehousing and introduce students to the various techniques and methodologies employed in data mining. This course also aims to demonstrate practical applications of data mining in everyday scenarios, showcasing its relevance and impact on decision-making, trend analysis, and predictive modelling.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the architecture of Data Warehouse and its implementation
CLO2	Analyze ETL data pre-processing techniques to effectively prepare data for mining algorithms.
CLO3	Evaluate the effectiveness of association rule mining algorithms and apply them to identify frequent patterns within a dataset
CLO4	Apply classification algorithms to construct models for data analysis and pattern recognition tasks.
CLO5	Create models for various clustering techniques to categorize data and delve into text mining, web mining, spatial data mining, and multimedia data mining.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	√				
CLO2		√			
CLO3			√		
CLO4			√		
CLO5					√

Course Content:

Module	Content	Hours
I Data Warehouse	Overview of Data Warehouse and OLAP (Online Analytical Processing) Technology, Data Warehouse Architecture, Data warehouse Implementation , From Data warehouse into Data Mining	12
II Data Mining	Data, Types of Data, Data Mining , Interestingness of patterns, Data Mining Vs. Knowledge discovery in Databases, Data Mining Functionalities, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining system with a Database or Data Warehouse System, Data Mining Applications- Major Issues in Data Mining.	12
III Data Pre Processing	Data Preprocessing Techniques: Data Cleaning, Data Integration, Data Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.	12

IV Data Mining Techniques & Classification and Prediction	Data Mining Techniques: Association and Correlation, Association Rule Mining, Apriori Algorithm, Frequent Pattern Growth-Mining Multilevel Association Rules Mining Multidimensional Association Rules Classification and Prediction: Issues regarding Classification and Prediction, Classification Methods: Decision Tree Induction , Bayesian Classification ,Rule Based classification , Back Propagation. Prediction: Regression Methods	15
V Clustering	Clustering: Cluster Analysis ,Types of data in cluster analysis Partitioning Methods, Density Based Methods, Hierarchical Methods, Grid Based Methods	9
	Mining Complex Data Types: Web Mining – Text Mining – Spatial Data Mining – Multimedia Data Mining	

Text Book

1. Jiawei Han and Micheline Kamber , “Data Mining: Concepts and Techniques” - Morgan Kaufmann Publishers, San Francisco, USA, 2006.

References

1. Anand Rajaraman and Jeffrey D.Ullman – “Mining of Massive Datasets”
2. Alex Berson and Stephen J. Smith , “Data Warehousing, Data Mining & OLAP” , Tata McGrew Hill Edition, 2007.

Online Resources:

<https://www.geeksforgeeks.org/data-mining/>

<https://www.javatpoint.com/data-warehouse>

Teaching Pedagogy:

- Lectures and Demonstrations
- Interactive Discussions
- Lab Sessions
- Team Projects
- Review of Research Papers

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Web Programming

Program Title	BCA
Course Title	Web Programming
Nature of Course	Discipline Specific Course
Semester	V
Total Hours	60
Credits	4

Objective:

To understand the basic model of a computer on processor design in which data representation and instruction basics, design of an ALU and the concepts of memory design are discussed.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the .Net Framework in developing C#. Net application
CLO2	Analyze Object-Oriented programming concepts in C# to effectively implement programming logic in Asp.net.
CLO3	Evaluate the database connectivity through ADO.net and assess the development of dynamic websites using Asp.net.
CLO4	Apply state management and data binding techniques in Asp.net.
CLO5	Create dynamic websites by learning the basics of PHP and applying it effectively.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓	✓	✓		
CLO2	✓	✓	✓		✓
CLO3	✓	✓	✓		✓
CLO4	✓	✓	✓		
CLO5	✓	✓	✓		✓

Course Content:

Module	Content	Hours
I Introduction to .NET Architecture	.NET framework : Common Language Runtime, Common Language Specification, Common Type System, MSIL, Garbage Collection, Security, Application domains -, Framework base classes, Assemblies, Namespaces, .Net Applications using C#, Advantages of .Net, Role of C# in .Net Framework.	10
II Object-oriented concepts in C#	Classes & Objects: Defining a class, member access modifiers, constructors ,types of constructors, destructor, 'this' reference, constant and read only members, properties, indexers. Inheritance & Polymorphism: Classical & containment inheritance, multilevel, hierarchical inheritance, operator overloading, overriding methods, abstract classes & methods, sealed classes & methods, polymorphism. Interfaces: Defining, extending, and implementing an interface, Interfaces & Inheritance, Abstract Class and Interfaces. Delegates: Introduction, declaration, methods, instantiation, invocation, using delegates, events.	15
III Programming in ASP.Net & Database Connectivity using ADO.Net	Introduction to ASP.Net: ASP.Net File Types, Applications, Code Behind technique, Global.asax File, Application Events. ASP.Net Configuration – Web.config file. Exploring Controls – Standard and Windows controls, Server Controls Data controls, Validation Controls, Handling Events. ADO.Net: Characteristics, ADO.Net Object Model, ADO.Net Data Access – Creating Connection, Command Object, Reading using DataReader Object, Updating data,	15
	Disconnected Data – Accessing, Modifying, Updating, Master Pages & Themes.	

<p style="text-align: center;">IV State Management & Data Binding</p>	<p>State Management: Viewstate, Querystring, Cookies, Session, Application.</p> <p>Data Binding: ListBox, DropDownList, CheckBox List, RadioButton List, Data Binding using Templates - Data List, Data Grid, Repeater, Form View, Page View.</p>	<p style="text-align: center;">10</p>
<p style="text-align: center;">V PHP</p>	<p>Introducing PHP: PHP Language Basics, Decisions and Loops, String, Array, Functions, Writing simple PHP programs. Working with databases: Creating MySQL database, Inserting Data, Accessing database in PHP, Updation and deletion of data items.</p>	<p style="text-align: center;">10</p>

References:

1. E. Balagursamy, "Programming in C#- A Primer", Tata McGraw Hill Publications, Third Edition, 2010.
2. Mridula Parihar, "Asp.net Bible", Wiley-Dreamtech India Pvt.Ltd, First Edition,2002
3. Steven Holzner, "PHP: The Complete Reference",McGraw Hill Education Pvt Ltd, Reprint 2015
4. Chris Bates, –Web Programming: Building Internet Applications||, Third Edition, Wiley India Edition, 2007.
5. Dr.Ravinder Singh, Amit Gupta, "Magic with HTML, DHTML and Javascript", Laxmi Publications, First Edition, 2009.
6. Herbert Schildt, "C# 4.0 : The Complete Reference", Tata McGraw Hill ,2010.
7. MacDonald , "The Complete Reference ASP.NET ", Tata McGraw Hill,2002 .
8. Matt Doyle, "Beginning PHP 5.3", Wiley Publishing, 2010
9. Deitel & Deitel , "Internet & World Wide Web –How to Program", Pearson Education, Fourth Edition, 2009

10. Jon Duckett, “ Beginning HTML, XHTML, CSS and JavaScript”, Wiley Publications, 2012.

11. Faithe Wempen, HTML 5 Step by Step, Microsoft Press, PHI, 2012.

Online Resources:

<https://www.geeksforgeeks.org/internet-and-web-programming/>

<https://www.w3schools.com/whatis/>

Teaching Pedagogy:

- Lecturing
- Developing applications using NetBeans
- Class work
- Demonstrating

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

BIG DATA ANALYTICS

Program Title	Bachelor of Computer Applications (BCA)
Course Title	Big Data Analytics
Nature of Course	Discipline Specific Elective
Semester	V
Total Hours	45
Credits	3

Objective:

The objective of this course is to provide students with a comprehensive understanding of Big Data Analytics and Hadoop technologies. Students will delve into the fundamentals of Big Data, exploring its characteristics and the challenges it poses to conventional systems. They will analyze the architecture and components of Hadoop, comparing it with other systems and understanding its evolution. Through hands-on experience, students will learn to work with the Hadoop Distributed File System (HDFS), MapReduce paradigm, and Big Data frameworks like Pig, Hive, HBase, and Zookeeper. By the end of the course, students will be equipped with the knowledge and skills to apply Big Data analytics tools and techniques effectively in real-world scenarios.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the fundamentals of Big Data Analytics, including the characteristics of Big Data, challenges posed by conventional systems, and the differentiation between traditional and Big Data business approaches. Analyze case studies to comprehend the solutions offered by Big Data in various domains.
CLO2	Apply Hadoop fundamentals, comparing Hadoop with other systems like Relational Database Management Systems, Grid Computing, and Volunteer Computing. Explore the history and evolution of Apache Hadoop to understand its significance in Big Data analytics.

CLO3	Analyze the Hadoop File System (HDFS), including its design, concepts such as blocks, name nodes, and data nodes, and advanced features like block caching, HDFS Federation, and High Availability. Utilize command-line interface and file system APIs to interact with HDFS effectively.
CLO4	Apply MapReduce paradigm for data processing, understanding data formats, the anatomy of MapReduce job execution, and scalability aspects. Analyze failures, shuffle, and sort operations, and comprehend various input and output formats used in MapReduce.
CLO5	Understand and apply Big Data frameworks such as Pig, Hive, HBase, Zookeeper, IBM InfoSphere Big Insights, and Streams for data processing and analytics. Utilize Pig and Hive for querying and processing data, and grasp the fundamentals of HBase and Zookeeper for managing Big Data applications effectively.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	√	√			
CLO2	√	√	√		
CLO3	√	√	√		
CLO4			√		
CLO5					

Course Content:

Module	Content	Hours
I Introduction to Big Data Analytics	Introduction to Big Data: Introduction to Big Data, Big Data characteristics, Challenges of Conventional System, Types of Big Data, Intelligent data analysis, Traditional vs. Big Data business approach, Case Study of Big Data Solutions.	07
II	Hadoop Fundamentals: Data, Data Analysis and storage, Comparison with other systems – Relational Database	08
Hadoop Fundamental	Management Systems, Grid Computing, Volunteer Computing, History of Apache Hadoop	
III Hadoop File System	Hadoop File System: The Hadoop Distributed File System the Design of HDFS, HDFS Concepts – Blocks, Name nodes and Data nodes, Block Caching, HDFS Federation, HDFS High Availability, The Command-Line Interface, Reading data from Hadoop URL, Reading Data using File system API, Writing Data, Directories, Querying the File system, Deleting Data	10
IV Map Reduce	Map Reduce: Data format, Analyzing the Data with Hadoop, Scaling Out Working of Map Reduce – Anatomy of a Map Reduce Job Run, Failures, Shuffle and Sort, Task Execution Map Reduce Formats – Input Formats, Output Formats.	10
V Frameworks	Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive services, HiveQL, Querying Data in Hive, fundamentals of HBase and Zookeeper, IBM InfoSphere Big Insights and Streams.	10

Text Book

1. Cielen, D., Meysman, A., & Ali, M. "Introducing Data Science: Big Data, Machine Learning, and more using Python tools." , Manning Publications Co,2016

Reference Books

1. Tom White, "Hadoop – The Definitive Guide; Storage and Analysis at Internet scale", O'Reilly, Shroff Publishers & Distributers Pvt. Ltd., 4th Edition, 2015.

2. DT Editorial Services "Big Data – Black Book" Dreamtech Press, Edition – 2015

3. Dirk deRoos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown, Rafael Coss"Hadoop for Dummies", John Wiley & Sons, Inc., 2014.

4. Nathan Marz and James Warren ,"Big Data Principles and Best Practices of Scalable Real time data systems", 2015.

Online Resource:

<https://www.ibm.com/analytics/big-data-analytics>

<https://www.geeksforgeeks.org/what-is-big-data-analytics/>

Teaching Pedagogy:

Lectures, Problem-solving and Practice sessions, Assignments in big data analytics and Assessment through tests and presentations.

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Image processing

Program Title	Bachelor of Computer Applications (BCA)
Course Title	Image Processing
Nature of Course	Discipline Specific Elective
Semester	V
Total Hours	45
Credits	3

Objective:

The course aims to acquaint students with a diverse array of algorithmic paradigms within the realm of Digital Image Processing (DIP). Through rigorous analysis, students will gain insights into the efficiency and efficacy of these algorithms, empowering them to make informed decisions regarding algorithm selection and design. By exploring a broad spectrum of algorithmic problems encountered in DIP, students will cultivate robust problem-solving skills. They will learn the art of dissecting complex problems into smaller, more manageable sub problems and applying suitable algorithmic techniques to solve them in a systematic and efficient manner. By the end of the course, students will emerge equipped with a profound understanding of DIP algorithms and the ability to tackle real-world image processing challenges adeptly.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the fundamentals of Digital Image Processing, including various stages involved in processing digital images.
CLO2	Analyze spatial operations and their applications in different image processing tasks such as image enhancement, image sharpening, and image resampling.
CLO3	Apply frequency domain concepts and operations, particularly frequency domain filtering, to improve image quality effectively.
CLO4	Evaluate various segmentation techniques and select appropriate methods to segment objects within images accurately.

CLO5	Create different morphological operations and implement them to segment objects based on their shapes in images
------	---

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	√	√			
CLO2	√	√	√		
CLO3	√	√	√		
CLO4			√		
CLO5					

Course Content:

Module	Content	Hours
I Fundamentals of Digital Image Processing	Fundamental steps in digital image processing, Components of image processing visual perception, image sensing and acquisition, sampling and quantization, mathematical tools used in digital image processing.	10
II Image Transformation & Filtering	Intensity transformation functions, Fundamentals of spatial filtering, smoothing and sharpening spatial filters	10
III Filtering in the frequency domain	Fourier series, Fourier transform of functions of continuous variable, Convolution, Discrete Fourier transformation of one variable, Sampling, Image interpolation and resampling, Moiré patterns, Properties of 2D discrete Fourier transform. Filtering basics and fundamentals	10
IV Morphological Processing	Morphological Processing: Dilation and Erosion, Opening and Closing, Hit-or miss transform	8
V Image Segmentation	Image Segmentation: Point, line and edge detection, Thresholding (Different Techniques), Region growing, Region splitting and merging	7

Text Book

1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Pearson Education, Third Edition.

Reference Books

1. William K Pratt, "Digital Image Processing", John Willey, June 2010.
2. A.K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 2011.
3. Chanda Dutta, Magundar, "Digital Image Processing and Applications", Prentice Hall

Online Resources:

<https://www.javatpoint.com/digital-image-processing-tutorial>

<https://www.geeksforgeeks.org/image-processing/>

Teaching Pedagogy:

Lectures, Problem-solving and Practice sessions, Assignments in image processing and Assessment through tests and presentations.

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Software Testing

Program Title	Bachelor of Computer Applications (BCA)
Course Title	Software testing
Nature of Course	Vocational Course
Semester	V
Total Hours	45
Credits	3

Objective:

Master the fundamentals of software testing and delve into automation testing techniques, specifically focusing on Selenium. Explore the principles behind testing methodologies, including unit, integration, and system testing, to ensure software quality. Gain proficiency in Selenium, a powerful tool for automating web application testing, to streamline the testing process. Bridge theory with practice by creating automated test scripts, executing tests, and analyzing results to validate software functionality effectively.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the fundamentals of testing, including the software testing life cycle and various types of testing methodologies.
CLO2	Analyze and implement software test automation techniques using Selenium for efficient and effective testing procedures.
CLO3	Apply Selenium Web Driver commands and techniques to design test cases for User Interface testing, ensuring comprehensive coverage of application functionalities
CLO4	Evaluate and identify different web elements within applications, ploying them to create structured and effective test cases.
CLO5	Create detailed test cases for Application Programming Interface (API) testing and Database Testing, demonstrating proficiency in designing tests to validate system functionality and data integrity.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PL01	PL02	PL03	PL04	PL05
CLO1	✓	✓			
CLO2		✓			
CLO3		✓	✓		
CLO4				✓	✓
CLO5				✓	✓

Software Testing		
Module	Description	Hours
I Introduction to Testing	Introduction and Fundamentals of Testing, Myths and Facts of Software Testing, Quality Assurance and Quality Control, Testing Objectives, Software Testing Life Cycle (STLC), Test Planning, Test-case Design Technique. Types of Testing- White Box testing, Black Box Testing, Integration Testing, Regression Testing, Validation Testing, Alpha Testing, Beta Testing, Acceptance Testing. Defect Management: Defect Management Process, JIRA Defect Tracking Tools.	10
II Introduction to Selenium Software Test Automation Tool	Software Test Automation: Fundamentals of Test Automation, Manual Testing Vs Test Automation, Terms used in Automation, Skills needed for Automation, Scope of Automation, Challenges in Automation. Selenium -WebDriver: Introduction to WebDriver, Installation of Selenium WebDriver, Creating the Scripts in WebDriver	10
III User Interface Testing	Web Element Locators, Xpath , id, LinkText, CSS Selector, Class Name, TagName WebDriver Commands: Browser Commands, getUrl(), getTitle(), getPageSource(), close(), Quit(), Navigation Commands, backward(), forward(), to(), refresh() WebElements Commands, Isselected(), IsEnabled(), getAttribute(), getText(),notify(), sendKeys(), submit(), wait()	10

<p style="text-align: center;">IV Handling Web Elements</p>	<p>CheckBox and Radio Button Operation, DropDown and Multiple select Operations, Handle Alert in WebDriver: dismiss(), accept(), getText(), sendKey(), Popup window handling in Web Drivers, getWindowHandle(), Wait commands in Web Drivers, Mouse Event using Action commands, Handling Multiple Windows, and IFrames, Running Test in Invisible Mode, Handling Dynamic Web Pages. Running selenium WebDriver in different popular Browser</p>	8
<p style="text-align: center;">V Application Programming Interface Testing</p>	<p>Introduction, API testing types, Command, tests on APIs, Advantages, Tasks involved, Tools used for API Testing, Challenges, Best Practices, Case study, Database Testing, Security Testing.</p>	7

Text Books

1. Rex Black: Advanced Software Testing—Vol. 1, Shroff Publishers, 2011.
2. Srinivasan Desikan Gopalswamy: Software Testing Principles and Practices, 5th Edition, Pearson Education, 2007.
3. Paul C. Jorgensen: Software Testing A Craftman’s Approach, 3rd Edition, Auernac Publications, 2008
4. David Burns: Selenium 2 Testing Tools: Beginner’s Guide, Packt Publishing, 2012.

Reference Book

1. Gundecha Unmesh: Selenium Testing Tools Cook Book, Packt Publishing, 2012

Online Resources:

<https://www.javatpoint.com/software-testing-tutorial>

<https://www.geeksforgeeks.org/software-testing-basics>

Teaching Pedagogy:

- Presentations on topic related to Software Testing
- Some Practical program on software testing/Blue Book

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Cyber Security

Program Title	Bachelor of Computer Applications
Course Title	Cyber Security
Nature of Course	Skill Enhancement Course
Semester	V
Total Hours	30
Credits	2

Objective:

This course is designed to equip students with the necessary knowledge and skills to tackle the complex legal and technical challenges of cybersecurity and digital forensics. It focuses on the legal aspects of cybersecurity, information security, and digital forensics, preparing students to handle cyber threats, investigations and related legal matters effectively.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the fundamental concepts of Cyber Security
CLO2	Identify the various forms of cyber attacks and analyze the cyber security needs of an organization
CLO3	Evaluate cyber security solutions and information assurance
CLO4	Apply security principles, policies and procedures to safeguard information system and to develop secure devices
CLO5	Create awareness about current trends in IPR and Govt. steps in fostering IPR

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓				
CLO2	✓	✓	✓	✓	✓
CLO3	✓	✓	✓	✓	✓
CLO4	✓	✓	✓	✓	✓
CLO5	✓			✓	✓

Course Content:

Module	Content	Hours
<p>I Introduction to Cyber Security and Cyber Crime</p>	<p>Introduction to Cyber Security: Basic Cyber Security Concepts, Vulnerability, Threat, Harmful acts, Computer Criminals, CIA Triad, , Motive of attackers, Types of Attacks-active attacks, passive attacks, Software attacks, hardware attacks. Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage. Cyber Crimes: Computer misuse, Identity theft, Hacking, Viruses, criminal damage and mail bombing, Denial of service attack, Obscenity, child abuse, Stalking. Morphing, web jacking, phishing etc.,</p>	<p>10</p>
<p>II Cyber Forensics</p>	<p>Cyber Forensics: Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics and Social Networking Sites: The Security/Privacy Threats, Challenges in Computer Forensics.</p>	<p>10</p>
<p>III Cyber Crime Tools and IPR in Cyber Security</p>	<p>Tools and Methods used in Cyber Crime: Introduction, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography and SQL Injection. IPR in Cyber Security: Introduction to IPR, Importance of IPR ,Types of IPR, Digital Copyrights, Open Source – Linking and caching – Patents, Software Patents – Trademarks and domain names, Challenges of IPR.</p>	<p>10</p>

Text Books:

1. Nina Godbole, SunitBelpure, "Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publications
2. Senthil, Surya, and Lakshmi Devi , "Manual of Cyber Laws" , Aditya Book Company, 2010.
3. S. R. Bhansali , "Information Technology Act 2000" , University Book House Pvt. Ltd., Jaipur 2003.
4. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema McGraw Hill Publications.

Online Resources:

https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

<https://www.kaspersky.co.in/resource-center/definitions/what-is-cyber-security>

Teaching Pedagogy:

Lectures, Tutorials, Practicals/Projects

Evaluation Pattern:

Continuous Internal Assessment	Seminar/Presentation Project	25 marks
Semester End Examination	SEE	25 marks
TOTAL		50 marks

Machine Learning

Program Title	Bachelor of Computer Applications
Course Title	Machine Learning
Nature of Course	Discipline Specific Course
Semester	VI
Total Hours	60
Credits	4

Objective:

Prioritize the development of algorithms geared towards facilitating machine learning processes, encompassing supervised and unsupervised learning methodologies. Focus on enabling machines to extract insights from data and autonomously make predictions or decisions, enhancing their capabilities. Emphasize algorithmic design to empower machines in understanding patterns, relationships, and trends within datasets, fostering predictive and decision-making abilities. Strive to imbue machines with the capacity to learn iteratively from both labeled and unlabeled data, advancing their proficiency in various learning tasks.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the fundamental issues and challenges of machine learning, including data, model selection, and model complexity
CLO2	Analyze the strengths and weaknesses of various machine learning approaches, enabling critical assessment and informed decision-making in algorithm selection and application.
CLO3	Evaluate the underlying relationships within and across Machine Learning algorithms, discerning the nuances of supervised and unsupervised learning paradigms for effective problem-solving.
CLO4	Apply machine learning principles to real-world datasets, demonstrating proficiency in implementing algorithms and interpreting results to address practical challenges.
CLO5	Create innovative solutions by integrating machine learning techniques with domain-specific knowledge, fostering creativity and adaptability in addressing complex problems.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓	✓			
CLO2	✓	✓	✓		
CLO3			✓		
CLO4				✓	
CLO5					✓

Course Content:

Machine Learning		
Module	Description	Hours
I Introducti on to Machine Learning	Introduction to Machine Learning: Introduction, what is Human Learning, Types of Human Learning, what is Machine Learning? Types of Machine Learning, Well-Posed Learning Problems Applications of Machine Learning, Tools in Machine Learning, Designing a Learning System. Perspectives and Issues in Machine Learning. Issues in Machine Learning.	7
II Exploring data	Exploring Data: Elements of structured Data, Machine Learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of Data, Data Quality and Remediation, Data Pre- Processing.	7
III Modelling and evaluation	Modelling, Evaluation and Feature Engineering: Introduction, selecting a Model, training a Model, Model Representation and Interpretability, Evaluating Performance of a Model, Improving Performance of a Model. Feature Engineering: Introduction, Feature Transformation, Feature Subset Selection.	12
IV Supervised learning	Supervised Learning: Introduction, Example, Classification Model, Classification Learning Steps, Common Classification Algorithms (k-Nearest Neighbour, Decision Tree, Random Forest Model, Support Vector Machines), Representation, Appropriate Problems for Decision Tree Learning, Basic Algorithm, Hypothesis Space Forest Model, Support Vector Machines).	12
V	Unsupervised Learning: Introduction, Unsupervised vs Supervised	10

Unsupervised learning	Learning, Applications of Unsupervised Learning, Clustering, Finding Patterns using Association Rule.	
------------------------------	---	--

Text Books

- 1.Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, “Machine Learning”, Pearson Education.
- 2.Tom M. Mitchell, “Machine Learning”, McGraw Hill Education.

Reference Book

- 1.E. Alpaydin, “Machine Learning”, MIT Press.
- 2.T. Hastie, R. Tibshirani and J. Friedman, “Elements of Statistical Learning”, Springer.
- 3.C. Bishop, “Pattern Recognition and Machine Learning”, Springer.
- 4.ShaiShalev-Shwartz, Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press
5. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packet Publishing 2013

Online Resource:

<https://www.geeksforgeeks.org/>
<https://www.javatpoint.com/>

Teaching Pedagogy:

- Presentations on topic related to Machine Learning
- Some Practical program on Machine Learning/Blue Book

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Cloud Computing

Program Title	Bachelor of Computer Applications
Course Title	Cloud Computing
Nature of Course	Discipline Specific Course
Semester	VI
Total Hours	60
Credits	4

Objective:

This course gives an insight into the frontier areas of cloud computing and virtualization along with its commercial tools and applications. It also explores technological drivers and cloud service providers, while equipping students with practical skills in managing and migrating applications to the cloud.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand cloud computing principles, architecture, and management, including migration and application deployment while evaluating its benefits and drawbacks.
CLO2	Apply knowledge deployment models (Private, Public, and Hybrid) and service models (IaaS, PaaS, SaaS) to real world scenarios, evaluating their suitability and implications.
CLO3	Evaluate the impact of technological drivers like SOA, virtualization, multicore technology, memory and storage technologies, networking technologies, Web 2.0, and Web 3.0, on cloud computing and programming models.
CLO4	Create an understanding of virtualization approaches and their role in cloud computing evolution. Explore key cloud service providers with a focus on Amazon Web Services through case studies.
CLO5	Analyze open-source tools for IaaS, PaaS, SaaS, and research support in cloud computing. Evaluate distributed computing tools like Cassandra, Hadoop, MongoDB, Ngrid, and Ganglia for managing distributed systems.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓				
CLO2	✓	✓	✓		
CLO3		✓	✓	✓	
CLO4					✓
CLO5	✓		✓		✓

Course Content:

Module	Content	Hours
I Cloud Computing Fundamentals and Architecture	Computing Paradigms - Cloud Computing Fundamentals- Motivation for Cloud Computing - Defining Cloud Computing- Principles of Cloud computing - Cloud Ecosystem - Requirements for Cloud Services - Cloud Application - Benefits and Drawbacks- Cloud Computing Architecture and Management Cloud Architecture - Anatomy of the Cloud- Network Connectivity in Cloud Computing -Applications on the Cloud- Managing the Cloud - Migrating Application to Cloud.	13
II Cloud Deployment and Service Models	Cloud Deployment Models – Introduction - Private Cloud - Public Cloud- Hybrid Cloud- Cloud Service Models- Infrastructure as a Service- Platform as a Service Software as a Service.	12
III Tech nolog ical Drive	Technological Drivers for Cloud Computing - SOA and Cloud- Virtualization Multicore Technology - Memory and Storage Technologies - Networking Technologies - Web 2.0	12
rs for Cloud Computing	- Web 3.0- Software Process Models for Cloud Programming Models- Operating System - Application Environment.	

<p style="text-align: center;">IV Virtualization and Cloud Services Providers</p>	<p>Virtualization - Approaches to Virtualization- Hypervisors - From Virtualization to Cloud Computing. Cloud Service Providers- EMC- Google - Amazon Web Services - Microsoft- - IBM- SAP Labs - Salesforce- Rackspace- VMware- Manjrasoft. Case Study: Amazon Web Services</p>	<p style="text-align: center;">13</p>
<p style="text-align: center;">V Open Source Support for Cloud</p>	<p>Open Source Support for Cloud- Introduction- Open Source Tools for IaaS- Open Source Tools for PaaS- Open Source Tools for SaaS- Open Source Tools for Research. Distributed Computing Tools for Management of Distributed Systems- Cassandra - Hadoop- MongoDB- Ngrid- Ganglia.</p>	<p style="text-align: center;">10</p>

Text Book

1. K. Chandrasekaran, "Essentials of Cloud Computing", CRC Press, Taylor & Francis Group, 2015.

Reference Books

1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", First Edition, John Wiley & Sons, 2011
2. Chellammal S, Pethuru Raj C., "Essentials of Cloud Computing", Second Edition, Springer, 2023.
3. Arshadeep Bagha and Vijay Madiseti, "Cloud Computing: A Hands-on Approach", Universities Press, 2014

Online Resource:

<https://www.geeksforgeeks.org/>

<https://www.javatpoint.com/>

Teaching Pedagogy:

- Lecturing
- Presentation
- Assignment

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Mobile Application Development

Program Title	Bachelor of Computer Applications
Course Title	Mobile Application Development
Nature of Course	Discipline Specific Course
Semester	VI
Total Hours	60
Credits	4

Objective:

To acquire the skills necessary to create functional and user-friendly applications for smartphones and tablets. By mastering mobile app development, individuals can tap into a rapidly growing market, unleash creativity through innovative solutions, and address diverse user needs.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CL01	Understand the basic architecture of Android OS
CL02	Analyze the utilization of Integrated Development Environment and Software Development Kits for the implementation of Android applications
CL03	Evaluate the implementation of different views, notifications, file manipulation and messaging functionalities within these applications, ensuring effective user interaction
CL04	Apply graphics and multimedia libraries in Android
CL05	Create Android applications that integrate functionalities such as Google map and database connectivity using SQLite, and then test, publish, and deploy these apps

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CL01	√				
CL02		√			
CL03		√			
CL04			√		
CL05				√	√

Course Content:

Module	Content	Hours
I Introduction to Android	Introduction-Introduction to Android, History of mobile technologies, Benefits and drawbacks of Smartphone programming, Android versions, Android features, Android Architecture, native libraries, SDK overview. "Hello World" program- Creating your first Android application, Anatomy of android Application, Understanding Activities, linking Activities using intents.	9
II Android User Interface	User Interface and Designing with views Understanding the components of a screen, adapting to display orientation, managing changes to screen orientation, layouts, Using Basic Views, Using Picker views, Using List views to display lists, applying a theme, adding a menu, Notifications, debugging with log messages, debugging with debugger.	14
III Graphics & Local Data in Android	Exploring 2D graphics and Multimedia Learning the basics, Adding Graphics, handling input, Using Image Views to display pictures, Playing audio, Playing Video Storing local Data Reading/writing local data, Accessing the Internal File system, Accessing SD card.	14
IV Location Services & Exploring SQLite	Location and Sensing SMS Messaging, Displaying MAPS, Location Data - Monitoring and Tracking a Location, Putting SQL to work Introducing SQLite, SQLiteOpenHelper, Creation, Insertion, Updation and Deletion of data, Data Binding, Using a content provider, Implementing content provider	12
V Testing and Publishing Android Application	Testing- significance, different approaches, types, test cases, activities in testing. Security- best practices, security with HTTPS and SSL, Android Keystore system, enhancing security with device management policies. iOS and iPhone apps- Introduction Preparing for Publishing- Versioning, Digitally Signing Your Android Applications. Deploying APK	11

	-Using the adb.exe Tool, Using a Web Server, Publishing on the Android Market	
--	---	--

Text Books

1. Grant Allen, "Beginning Android 4", Apress, 2012
2. Wei-Meng Lee, "Beginning Android 4 Application Development", John Wiley & sons, Inc, 2012.

References

1. Ed Burnette, Hello, Android: Introducing Google's Mobile Development Platform, Pragmatic. Bookshelf (2009), ISBN-13: 978-1934356173.
2. Jerome (J.F) DiMarzio, "Android - A programmer's Guide", Tata McGraw Hill, 2010, ISBN: 9780071070591.

Online Resources:

<https://www.geeksforgeeks.org/android-tutorial>

<https://www.tutorialspoint.com/mobile-development-tutorials.html>

Teaching Pedagogy:

- Lectures and Demonstrations
- Interactive Discussions
- Lab Sessions
- Team Projects

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

NoSQL

Program Title	Bachelor of Computer Applications
Course Title	NoSQL
Nature of Course	Discipline Specific Elective
Semester	VI
Total Hours	45
Credits	3

Objective of the Course:

To Develop an understanding of fundamental concepts underlying NoSQL databases, including their architecture, data models, query languages, and scalability. Gain proficiency in distinguishing between different types of NoSQL databases. Explore the principles behind NoSQL database design and distributed database systems for deeper insights.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understanding the concept of NoSQL database and interacting with NoSQL
CLO2	Analyse the framework of NoSQL
CLO3	Evaluate the principles, architecture, and scalability of various data stores
CLO4	Apply advanced querying and indexing techniques to efficiently manipulate and retrieve data in NoSQL databases.
CLO5	Create database schemas that are robust and customized to meet the unique requirements of specific applications.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓				
CLO2		✓			
CLO3		✓	✓		✓
CLO4	✓		✓		
CLO5			✓	✓	✓

Course Content:

Module	Content	Hours
I Introduction to NoSQL	Introduction to NoSQL: Definition And Introduction, Sorted Ordered Column-Oriented Stores, Key/Value Stores, Document Databases, Graph Databases, Examining Two Simple Examples, Location Preferences Store, Car Make And Model Database	9
II Interacting with NoSQL	Interacting with NoSQL: If NoSql Then What, Language Bindings For NoSQL Data Stores, Performing Crud Operations, Creating Records, Accessing Data, Updating And Deleting Data	10
III Storage Architecture	NoSQL Storage Architecture: Working With Column-Oriented Databases, Hbase Distributed Storage Architecture, Document Store Internals, Understanding Key/Value Stores In Memcached And Redis, Eventually Consistent Non-Relational Databases.	10
IV NoSQL Stores	NoSQL Stores: Similarities Between Sql And Mongodb Query Features, Accessing Data From Column-Oriented Databases Like Hbase, Querying Redis Data Stores, Changing Document Databases, Schema Evolution In Column-Oriented Databases, Hbase Data Import And Export, Data Evolution In Key/Value Stores.	8
V Indexing and Ordering Data Sets	Indexing and Ordering Data Sets : Essential Concepts Behind A Database Index, Indexing And Ordering In Mongodb, Creating and Using Indexes In Mongodb, Indexing And Ordering In Couchdb.	8

References:

1. Shashank Tiwari, Professional NoSQL, Wrox Press, Wiley, 2011
2. Pramod Sadalage and Martin Fowler, NoSQL Distilled, Addison-Wesley Professional, 2012.
3. Gaurav Vaish, Getting Started with NoSQL, Packt Publishing, 2013.
4. Dan McCreary and Ann Kelly, Making Sense of NoSQL, Manning Publications, 2013.

Online Resources:

<https://www.mongodb.com/nosql-explained>

<https://www.oracle.com/in/database/nosql/what-is-nosql/>

Teaching Pedagogy:

- Quiz
- Hands-On Exploration
- Case Studies and projects

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Internet of Things

Program Title	Bachelor of Computer Applications
Course Title	Internet of Things
Nature of Course	Discipline Specific Elective
Semester	VI
Total Hours	45
Credits	3

Objective of the Course:

This course aims to explore IoT and M2M technologies, covering definitions, enabling technologies, and domain specific applications. Students will engage in hands on projects with IoT physical devices and cloud platforms like WAP, Xively and Amazon web services.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the IOT's core concept, design, principles and technologies covering physical and logical aspects and deployment strategies. Explore the wide ranging applications of IOT across various sectors.
CLO2	Analyse IoT-M2M in architecture and applications. Explore wireless sensor networks, M2M communication and connectivity technologies like blue tooth, RFID, Wireless HART, and NFD.
CLO3	Apply IoT platform design methodology, develop specifications, understand integration techniques and explore application development in IoT platform environments.
CLO4	Evaluate IoT physical devices and like Raspberry Pi interfaces. Implement IoT projects including sensor based measurements, Wi-Fi connectivity and database integration on Raspberry Pi.
CLO5	Create IoT applications using physical servers and cloud platforms like WAMP, Xively, python frameworks and AWS, demonstrating proficiency in deployment and management.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓			✓	
CLO2		✓			
CLO3		✓	✓	✓	
CLO4				✓	✓
CLO5	✓		✓		✓

Course Content:

Module	Content	Hours
I Introduction	Introduction: Definition & characteristics of IoT - physical design of IoT - logical design of IoT - IoT enabling Technologies - IoT levels & Deployment templates. Domain-specific IoTs: Home Automation - cities - Environment - Energy - retail -logistics - Agriculture - Industry - Health and lifestyle.	7
II IoT and M2M	IoT and M2M - Deference between IoT and M2M. Wireless Sensor Network and M2M Communication. Connectivity Technologies: Bluetooth, RFID, Wireless HART. NFD.	10
III IoT Specification	IoT platforms design Methodology - purpose and specification - process specification - Domain model specification - Information model specification - Service specification - IoT level specification - functional view specification - operational view specification - Device and component Integrators – Application Development	8
IV Logical Design Using Python	IoT physical devices and End points, building blocks of IoT device - Raspberry Pi - Linux on Raspberry Pi - Raspberry Pi interfaces. IoT Project: Measure the Distance Using Ultrasonic Sensor and Make Led Blink - Detect the Vibration of an Object - Connect with the Available Wi-Fi - Temperature Notification - MySQL Database Installation in Raspberry Pi - MySQL Database Installation in Raspberry Pi.	10
V IoT & Cloud Computing	IoT physical servers & cloud computing - WAMP - Xively cloud for IoT - python Web application frame work - Amazon web services for IoT.	10

Text Book

1. Internet of Things - A hands on Approach Authors: Arshdeep Bahga, Vijay Madiseti
Publisher: Universities press

Reference Books

1. Internet of Things - Srinivasa K.G., Siddesh G.M. Hanumantha Raju R. Publisher:
Cengage Learning India pvt. Ltd (2018)

Online Resource:

<https://www.javatpoint.com/iot-internet-of-things>

https://www.tutorialspoint.com/internet_of_things/index.html

Teaching Pedagogy:

- Lecturing
- Presentation
- Simulation
- Assignment

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Linux Administration

Program Title	Bachelor of Computer Application
Course Title	Linux Administration
Nature of Course	Vocational Course- II
Semester	VI
Total Hours	45
Credits	3

Objective:

This course is designed to equip learners with the foundational skills and knowledge required to manage Linux systems. Students will learn to do file processing, process management, I/O management, queues management, networking, storage backup, account management, proper system start-up and shutting down, as well as other tasks.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the fundamental concept of a Linux file system and learn techniques to search for files using various commands
CLO2	Analyze process management including creating, monitoring, and terminating processes
CLO3	Evaluate firewall rules and implement the system security
CLO4	Apply security credentials for the user accounts and system controls
CLO5	Create manage network services on a Linux system

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓			✓	
CLO2	✓	✓		✓	✓
CLO3	✓	✓	✓	✓	✓
CLO4	✓	✓	✓	✓	✓
CLO5	✓		✓	✓	✓

Course Content:

Module	Content	Hours
I Managing Files from Command Line	Managing Files from Command Line - Linux file system hierarchy - Locating files and directories by Name - Linux file system default permissions and access - Managing Linux file system permission - Controlling new file permission and ownership- File management and manipulation - Moving users & its directories - Miscellaneous Tools- Editors	9
II Monitoring and Managing Linux Process and LOGS	Monitoring and Managing Linux Process and LOGS - Linux process - Controlling Jobs - Background Process and Foreground Process - Monitoring Process Activity - Killing Processes - Reviewing syslog files	8
III Managing Linux Users	Managing Linux Users - Creating and managing user/s and group commands, User management Tools-Users and Access Permissions -Updating users and group attributes -PAM (Pluggable Authentication Modules)	8
IV Bootting, File Systems and Core System Services	Bootting, File Systems and Core System Services - Boot Loaders- The init process- rc scripts- enabling and disabling services-bootting and shutting down- Bootting in recovery mode - Makeup of file systems, Managing file systems, Adding a new disk, Volume Management, Creating file systems. The init Daemon, xinetd and inetd, The Logging Daemon, Configuring Logging Daemon, The CRON program	10
V Servers and Internet Services	Servers and Internet Services -DNS- Installing DNS Server, Configuring DNS server, DNS records types, Setting up BIND database file, The DNS Toolbox, Configuring DNS clients - Virtualization - Virtualization Implementation, Kernel based Virtual Machines (KVM)- Web Server - Understanding and Installing HTTP - Configuring Apache.	10

Text Books:

1. Steve Shah and Wale Soyinka “ Linux Administration: A Begineer’s Guide”, 4th Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi.
2. Susan Lauber, Philip Sweany, Rudolf Kastl and George Hacker, “REDHAT System Administration-1 Student Work book”, REDHAT Inc. 2014

References:

1. Mokhtar Ebrahim, Andrew Mallett, “Mastering Linux Shell Scripting”, Pack Publishing, 2nd Edition, 2018.
2. Richard Blum, Christine Bresnahan, “Linux Command Line and Shell Scripting BIBLE”, Wiley Publishing, 3rd Edition, 2015.
3. Robert Love, “Linux System Programming”, O'Reilly Media, Inc, 2013

Online Resources:

Linux Security By Paul Cobbaut - <http://linux-training.be/>
<https://nptel.ac.in/courses/117106113>

Teaching Pedagogy:

Lectures, Tutorials, Practicals

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Design Thinking

Program Title	Bachelor of Computer Applications
Course Title	Design Thinking
Nature of Course	Skill Enhancement Course
Semester	VI
Total Hours	30
Credits	2

Objective:

Equip with the knowledge and skills necessary to apply design thinking principles and methodologies effectively in problem-solving contexts across various domains. Through experiential learning activities and collaborative projects, students will develop a deep understanding of human-centered design principles, empathy-driven innovation, and iterative prototyping techniques.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Analyze and apply critical theories of design, systems thinking, and design methodologies to deconstruct and evaluate existing designs, systems, and processes, identifying opportunities for improvement and innovation.
CLO2	Develop and implement great designs by integrating principles of design thinking, systems thinking, and design methodologies, resulting in innovative and effective solutions to complex engineering problems.
CLO3	Communicate with high emotional and intellectual impact by effectively articulating design concepts, rationale, and solutions to diverse stakeholders using persuasive storytelling techniques and visual communication tools.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓				
CLO2		✓			
CLO3			✓		

Course Content:

Module	Content	Hours
I	Design process: Traditional design, Design thinking, Existing sample design projects, Study on designs around us, Compositions/structure of a design Innovative design: Breaking of patterns, Reframe existing design problems, Principles of creativity Empathy: Customer Needs, Insight-leaving from the lives of others/standing on the shoes of others, Observation.	10
II	Design team-Team formation, Conceptualization: Visual thinking, Drawing/sketching, New concept thinking, Patents and Intellectual Property, Concept Generation Methodologies, Concept Selection, Concept Testing, Opportunity identification	10
III	Prototyping: Principles of prototyping, Prototyping technologies, Prototype using simple things, Wooden model, Clay model, 3D printing; Experimenting/testing. Case study.	10

References:

1. R. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd.
2. IdrisMootee, Design Thinking for Strategic Innovation,2013, John Wiley & Sons Inc

Online Resources:

<https://www.tutorialspoint.com/hi/design-thinking/design-thinking-tutorial.pdf>

<https://aim.gov.in/pdf/Design-Thinking.pdf>

Teaching Pedagogy:

- Lectures and Demonstrations
- Group assignments
- Case Studies

Evaluation Pattern:

Continuous Internal Assessment	Seminar/Presentation	10 marks
	Project	15 marks
Semester End Examination	SEE	50 marks
TOTAL		75 marks

Open Electives offered by the Department

Web Technologies

Program Title	Bachelor of Computer Applications
Course Title	Web Technologies
Nature of Course	Open Elective
Semester	I
Total Hours	45
Credits	3

Objective:

Developing skills to create dynamic web pages empowers you to harness the full potential of the web as a medium of communication. Whether you're building a personal blog, an e-commerce website, a corporate intranet, or a social networking platform, proficiency in web development enables you to create engaging, interactive, and impactful digital experiences.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the concept of internet technologies and web programming techniques.
CLO2	Design and Develop interactive web pages using Bootstrap, JavaScript and dynamic HTML.
CLO3	Understand the importance of PHP for web interaction and web hosting.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	√	√			
CLO2			√	√	
CLO3	√	√			√

Course Content:

Module	Content	Hours
I Understanding Web Technologies	Fundamentals of Web: History of Internet, Internet Services, WWW, Web Browser and Web Server, Planning Process, Five Golden Rules of web designing, Basics of HTML. Bootstrap: Introducing Bootstrap, Working with Layouts – working with containers, inserting rows and columns to layout, Working with Content – Headings, Paragraphs, Lists, Coding Tables, Images, badges, Typography, Colors, Alerts, Jumbotron, Forms, Form inputs, Components – Button, Button groups, Checkbox and Radio buttons, navbar, Progress bar.	12
II Dynamic page using JavaScript and PHP	Java Script: Introduction to Java script, Features of Java Script, Including Java Script in HTML file, Simple Examples, communicating with user – alert (), prompt (), confirm () methods, Function, Creating Interactive forms, Working with form elements. PHP: Introduction to PHP, Syntax, Comments, Variables, Data types, Decisions and Loops, String, Functions, Writing simple PHP programs, Cookies and Sessions.	10
III Connecting MySQL with PHP and Deployment of website	Working with databases: Creating MySQL database, Naming Database Elements, Choosing Column Types and Properties, connecting to MySQL, Inserting Data, Accessing database in PHP. Deployment of website: Introduction to deployment of website, Types of deployments, Steps to deploy a website on internet, Platform available for deployment.	8

Text Books

1. Deitel & Deitel ,“Internet & World Wide Web –How to Program”, Pearson Education, Fourth Edition, 2009 (Module –I).
2. Matt Lambert, “Learning Bootstrap 4”, Second Edition, Packet Publishing, 2016. (Module –I)
3. Jon Duckett, “ Beginning HTML, XHTML, CSS and JavaScript”, Wiley Publications, 2012 (Module –II).
4. Steven Holzner, “PHP: The Complete Reference”,McGraw Hill Education Pvt Ltd, Reprint 2015 (Module –III)

Online Resources:

<https://www.w3schools.com/html/>
<https://www.w3schools.com/bootstrap/>
<https://www.w3schools.com/php/>

Teaching Pedagogy:

- Lectures and Demonstrations
- Interactive Discussions
- Lab Sessions
- Team Projects
- Review of Research Papers

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Python Programming

Program Title	Bachelor of Computer Applications
Course Title	Python Programming
Nature of Course	Open Elective
Semester	II
Total Hours	45
Credits	3

Objective:

To furnish students with a thorough comprehension of Python script writing and the exploration of its functionalities and also adept at harnessing its advanced features, and capable of crafting robust and efficient applications.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand the diverse range of data types and packages available in Python
CLO2	Analyze problem statements and employ critical thinking skills to design appropriate Python programs
CLO3	Evaluate Python's advanced features in object-oriented programming (OOP)
CLO4	Apply Python's advanced features to design and develop interactive GUI applications
CLO5	Create complex Python applications, showcasing creativity and innovation in problem-solving, utilizing both fundamental concepts and advanced features.

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES

	PL01	PL02	PL03	PL04	PL05
CLO1	✓	✓			
CLO2		✓			
CLO3			✓		

CLO4				✓	✓
CLO5					✓

Couse Outcomes:

Python Programming		
Module	Description	Hours
I Basics, Control Structures & Other Features	Python Basics: First Python Script, Basic Data Types, Identifiers, Keywords, Variables, Basic Input and Output. Python Control Structures: Decisions,Loops, Terminating Control. Lists: Creating, Accessing & Counting List elements, List Slices, Adding and Deleting elements Tuples: Creating Tuples, Accessing, Counting and Iterating through tuple elements, Searching elements, Tuple Slices. Dictionaries: Creating Dictionaries, Accessing, Counting and Iterating through dictionary elements, Searching elements.	8
II Strings , Functions & Practical Python	Strings: Search, Split, Join, Modify, Replace operations. Functions: Definition, Function Call, Positional Arguments, Default, Keyword and Variable Arguments, Returning from Functions, Returning Single Values and Collections from Functions. Practical Python: map(), filter() and reduce() functions	8
III Object Oriented Programming in Python	OOP in Python: Overview of OOP Principles, Defining class, Instantiating class, Instance Variables and Class Variables, Constructors and Destructors, Private, Public and Protected members Simple Inheritance, Function Overriding, Multiple Inheritance, Polymorphism. Exceptions, Python Libraries. Data processing with GUI.	14

Text Book

1. B. Nagesh Rao, " Learning Python", CyberPlus Infotech Pvt.Ltd, 2017
2. Allen B. Downey, "Think Python", O' ReillyMedia Inc; 2016
- Matic C.Brown, "The Complete Reference Python",M.C.Graw HillEducation, 2001.
3. Alan D. Moore & B. M. Harwani," Python GUI Programming - A Complete Reference Guide", Packt Publishing Ltd,2019
4. Burkhard A, Meier "Python GUI Programming Cookbook" Packt Publishing Ltd,2015

Online Resource:

<https://www.python.org/doc/>

<https://realpython.com/>

Teaching Pedagogy:

- Lab Programs
- Designing Application (Such as games,gui,etc)

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks

Data Visualization Techniques Using Tableau

Program Title	Bachelor of Computer Applications (BCA)
Course Title	Data Visualization Techniques Using Tableau
Nature of Course	Open Elective
Semester	III
Total Hours	45
Credits	03

Objective:

To enable analysts and decision-makers to extract actionable insights from large volumes of data. By presenting information through charts, graphs, and interactive visualizations, it becomes easier to identify trends, patterns, and outliers. Data visualization enhances understanding, facilitates informed decision-making, and drives strategic outcomes across various industries and disciplines.

Course Learning Outcomes:

COURSE LEARNING OUTCOMES	
CLO1	Understand and interpret data through visualizations
CLO2	Analyze appropriate data visualization techniques for a particular type of data
CLO3	Evaluate the effectiveness of various visualization methods in conveying complex datasets to different audiences.
CLO4	Apply appropriate filters and actions to create a Story.
CLO5	Create exploratory data analysis for various projects and illustrate the results through visualization

MAPPING OF COURSE LEARNING OUTCOMES TO PROGRAM LEARNING OUTCOMES					
	PLO1	PLO2	PLO3	PLO4	PLO5
CLO1	✓				
CLO2		✓	✓		
CLO3	✓	✓	✓	✓	
CLO4	✓	✓			
CLO5	✓	✓			✓

Course Content:

Module	Content	Hours
I	Introduction to data visualization: Introduction- Data visualization options – Data for data visualization- Design principles- Categorical, time series, and statistical data visualization	08
II	Tableau: Introduction to Tableau- installation, architecture, and environment. Various data sources, data joining, data blending, and Worksheets in Tableau.	10
III	Operators and Filters in Tableau: Operators, Functions, Numeric and Non- -numeric calculations, Sorts and filters in Tableau- Basic, Quick, Context, Condition and Top filters	10
IV	Charts and Plots: The Visualization Dashboard, Charts in Tableau- bar chart, line chart, pie chart, crosstab, scatter plot, bubble chart, bullet graph, box plot, tree map, bump chart, Gantt chart, histogram, motion chart, and waterfall chart.	10
V	Introduction to other visualization tools: R, Plotly in Python, Sea Born library in Python, d3.js library	7

Text Books :

1. Alexander Loth, “Visual Analytics with Tableau”, Wiley Publications, 1st edition (2019).
2. Claus O Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, O’Reilly Media Publications, 1st edition (2019).

3. Ryan Sleeper, "Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master", O' Reilly Media Publications, 1st edition (2018).

Online Resources:

<https://www.geeksforgeeks.org/>

<https://www.tutorialspoint.com/>

Teaching Pedagogy:

- Active Learning
- Real-World Examples
- Collaborative Learning
- Tool Exploration
- Emphasis on Communication

Evaluation Pattern:

Continuous Internal Assessment	Test 1	30 marks scaled down to 10
	Test 2	30 marks scaled down to 10
	Seminar/Presentation	10 marks
	Project	10 marks
Semester End Examination	SEE	60 marks
TOTAL		100 marks