NATIONAL EDUCATION POLICY-2020

Bachelor of Science (Information Technology) -

B.Sc (I.T)

PROPOSED STRUCTURE FOR

Bachelor of Science (Information Technology) (B.Sc-IT)

2025-26

Sri Dev Suman Uttarakhand University

Badshahithaul (Tehri Garhwal) Uttarakhand -249199

(State University of Uttarakhand)

CURRICULUM DESIGN COMMITTEE,
UTTARAKHAND

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Sri Dev Suman Uttarakhand University

Badshahithaul (Tehri Garhwal)

Bachelor of Science - I.T

Members of Board of Studies

S. No	Name & Designation	Board of Studies	Signature
1.	Prof. G.K Dhingra , Dean Faculty of Science , Sri Dev Suman Uttarakhand University	Chairman & Convenor BoS, (Professional Courses)	17/6/2025
2.	Dr. Gaurav Varshney ',BCA Coordinator, Sri Dev Suman Uttarakhand University	Convenor	17/06/25
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4.	Dr. M. K. Sharma, Professor, Department of Computer Science, Amrapali University , Haldwani	Member (Subject Expert)	Online
5.	Dr. Rakesh Mohan Bhatt,Professor, Department of Computer Science, ITM Dehradun	Member (Subject Expert)	17.6.25
6.	Dr. Naveen Mahajan, Department of BCA, Govt. Degree College, Rudraprayag , Uttarakhand	Member (Subject Expert)	17.6.25

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Table of Contents

Course Structure for Bachelor of Science (Information Technology) Programme as Per NEP 2020

Semester	**Core** discipline specific Course (**4 Credits) DSC**	**Core** Discipline specific Course (**4 Credits) DSC**	**Core** Discipline specificCourse **(4 Credits) DSC**	Ability Enhancement Course **(2 Credits) (AEC)**	Discipline specific Elective Course/Generic Elective **4- credits (DSE/GE)**	Skill Enhancement Course **2 Credits (SEC)**	Value Added Course **(2 Credits) (VAC)**	IAPC	Total Credits
I	Programming In C (3) + Programming in C Lab (2)	Fundamental Of Computer (3) + Fundamental Of Computer Lab(2)	Mathematics Foundation (4)	Choose one from a pool of AEC courses (2)	_Choose one from a pool of GE courses (4)	Choose one from a pool of SEC courses (2)	Choose one from a pool of VAC courses (2)	-	22
II	Data Structure & Algorithms (3) + Data Structure & Algorithms Lab (2)	Object-Oriented Programming Using C ++(3) + Object-Oriented Programming Using C ++ Lab (2))	Computer System Architecture(4)	Choose one from a pool of AEC courses (2)	-_Choose one from a pool of GE courses (4)	Choose one from a pool of SEC courses (2)	Choose one from a pool of VAC courses (2)	-	22

Exit option with Certificate in Information Technology (40 Credits)

Semester	**Core** discipline specific Course (**4 Credits) DSC**	**Core** Discipline specific Course (**4 Credits) DSC**	**Core** Discipline specificCourse **(4 Credits) DSC**	Ability Enhancement Course **(2 Credits) (AEC)**	Discipline specific Elective Course/Generic Elective **4- credits (DSE/GE)**	Skill Enhancement Course **2 Credits (SEC)**	Value Added Course **(2 Credits) (VAC)**		**Total Credits**
III	Java Programming (3) + Java Programming Lab (2)	Database Management System (3) + Database Management Systems LAB (2)	Operating System (4)	Choose one from a pool of AEC courses (2)	Choose one from a pool of DSE or GE courses (2)	Choose one from a pool of SEC courses (2)	Choose one from a pool of VAC courses (2)	-	22
IV	Python Programming (3) + Python Programming Lab (2)	Internet Of Things (3) + Internet of Things Lab (1)	Design and Analysis of Algorithm (4)	Choose one from a pool of AEC courses (2)	Choose one from a pool of DSE or GE courses (2)	Choose one from a pool of SEC courses (2)	Choose one from a pool of VAC courses (2))	-	22

Exit option with Diploma in Information Technology(88 Credits)								
Semester	**Core** discipline specific Course (**4 Credits) DSC**	**Core** Discipline specific Course **(4 Credits) DSC**	**Core** Discipline specificCourse **(4 Credits) DSC**	Ability Enhancement Course **(AEC)**	Discipline specific Elective Course/Generic Elective **4- credits (DSE/GE)**	Skill Enhancement Course **2 Credits (SEC)**	**Apprenticeship/Project-(2-Credits)**	Total Credits
V	Computer Network (3) + Computer Network Lab 21)	Artificial Intelligence (3) + Artificial Intelligence Lab(2)	Software Engineering (4)	-	Choose one from a pool of DSE courses (4) and One from Pool of GE Course(4)	-	Internship/ Apprenticeship/ Project/ Community Outreach/Field Work(2-credit)	22
VI	Data Analytics with R (3) + Data Analytics with R lab (2)	Android Programming (3) + Android Programming Lab (2)	Cloud Computing (4)	-	Choose one from a pool of DSE courses (4) and One from Pool of GE Course(4)	-	Internship/ Apprenticeship/ Project/ Community Outreach/Field Work(2-credit)	22

Exit option with Degree in Bachelor of Science (Information Technology) (132 Credits)						
Semester	**Core** discipline specific Course **(4 Credits) DSC**	Ability Enhancement Course **(AEC)**	Discipline specific Elective Course/Generic Elective **4- credits (DSE/GE)**	Skill Enhancement Course **2 Credits (SEC)**	**Disseratation**	Total Credits
VII	Machine Learning(3) + Machine Learning lab (2)	-	Choose 3 DSE Courses. Each 4 Credit Or Choose 2 DSE each 4 credit 1 GE 4 credit course Or Choose 1		Dissertation Major 6 credits/Dissertation Minor 6 credit/Academic Project/Entrepreneurship-6 credits	22

			DSE 4 credit and 2 GE 4 credit each courses			
VII I	Deep Learning (3) + Deep Learning Lab(2)		Choose 3 DSE Courses. Each 4 Credit Or Choose 2 DSE each 4 credit 1 GE 4 credit course Or Choose 1 DSE 4 credit and 2 GE 4 credit each courses		Dissertation Major 6 credits/Dissertation Minor 6 credit/Academic Project/Entrepreneurship-6 credits	22
Exit option with Degree in Bachelor of Bachelor of Science (Computer Science) with Research (176 Credits)						

SEMESTER –I

BSCIT101(DSC)	Programming in C	3L:0T:2P	4 Credits

Course Objective: Understand basic terminology of computers, problem solving, programming Languages and their evolution. Design the solution from specification of a problem and write pseudo code of the algorithm using basic building blocks or structured programming constructs (Sequence, Selection and Repetition statement). Testing and analyzing programs using debugging tools.

Course Outcome: By the end of this course, students should be able to:

1. Understand basic programming concepts.
2. Develop problem solving skills.
3. Control the sequence of the program and give logical outputs.
4. Apply code reusability with functions and pointers.
5. Understand the basics of file handling mechanisms.

Course Content:

UNIT I:
Evolution of C, Programming languages, Structure of a C program, Compiling a C program, Character set in C, Keywords in C, Hierarchy of operators, Basic data types, Qualifiers used with basic data types, Variables in C, Type declaration, Output function, Input function and format specifiers, arithmetic operators, Unary operators, Relational and logical operators.

UNIT II:
if statement, if else statement, for statement, while loop, do while statements, break statements, continue statements, switch statement, goto statement, ternary operators.

UNIT III:
Advantages of arrays, types of arrays, array declaration, array initialization, accessing data from array, array inside the memory, multidimensional arrays. Character arrays, Array overflow, String Variables, Reading & writing strings, string handling functions.

UNIT IV:
Advantages of functions, declaring a function, calling a function, variables, passing arguments to a function, nested functions, passing array to functions, recursion in functions, Call by value and Call by reference. Pointers and function, Array of pointers, Pointer and Strings, Pointer to structure, Pointers within structure, Introduction of Static and Dynamic memory allocation, Dynamic memory allocation, DMA functions, malloc () function, Size of () operator, Function free (), Function realloc ().

UNIT V:
Introduction, File structure, File handling function, File types, Streams, Text, Binary, File system basics, the file pointer, opening a file, closing a file, writing a character, reading a character, Using fopen( ), getc( ), putc( ), and fclose( ), Using feof( )

Recommended Books:

1. AICTE's Programming for Problem Solving (with Lab Manual), Khanna Book Publishing Company, 2024.
2. Harvey Deitel and Paul Deitel, C How to Program, 9th edition, Pearson India, 2015.
3. R G Dromey, How to Solve It by Computer.

BSCIT102(DSC)	Fundamental of Computer	3L:0T:2P	4 Credits

Course Objective: The objective of this course is to introduce students to the essential concepts and principles of computer science and also seeks to cultivate problem-solving abilities and analytical thinking, fostering a strong foundation for future studies and careers in the computing industry.

Course Outcome: By the end of this course, students should be able to:

1. Understand computer system characteristics, including hardware and software components.
2. Familiarize with number systems: decimal, binary, octal, and hexadecimal, along with logic gates and truth tables.
3. Identify various input devices like keyboards, scanners, and pointing devices, and output devices such as printers and projectors.
4. Describe the components of a Central Processing Unit (CPU) and memory (RAM and ROM).

Course Content/Syllabus:

Unit 1: Introduction to Computer Systems and Types

Computer system: characteristics and capabilities. Computer Hardware and Software: Block Diagram of a Computer, Different Data Processing: Data, Data Processing System, Storing Data, Processing Data. Types of Computers: Analogue, Digital, Hybrid, General and Special Purpose Computers. Generation of Computers. Computer Systems: Micros, Minis & Main-frames. Limitations of Micro Computer.

Unit 2: Number Systems and Logic Gates

Number systems: Decimal Number system, Binary number system, Octal & Hexadecimal number system, 1's & 2's complement Codes: ASCH, EBCDI Codes, Gray code & BCD.

Logic Gates: AND, OR, NOT GATES and their Truth tables, NOR, NAND & XOR gates

Unit 3: Input Devices and Computer Output

Introduction to Input Devices: Categorizing Input Hardware, Keyboard, Direct Entry — Card Readers, Scanning Devices — O.M.R., Character Readers, Thumb Scanner, MICR, Smart Cards, Voice Input Devices, Pointing Devices — Mouse, Light Pen, Touch Screen.

Computer Output: Output Fundamentals, Hardcopy Output Devices, Impact Printers, Non-Impact Printers, Plotters, Computer output Microfilm/Microfiche (COM) systems, Softcopy Output Devices, Cathode Ray Tube, Flat Screen Technologies, Projectors, Speakers.

Unit 4: Central Processing Unit (CPU)

Central Processing Unit: The Microprocessor, control unit, A.L.U., Registers, Buses, Main Memory, Main Memory (RAM) for microcomputers, Read Only Memory (ROM).

Unit 5: Storage Devices and Data Storage Methods

Storage Devices: Storage Fundamentals, Primary and Secondary Storage, Data Storage and Retrieval Methods — Sequential, Direct & Indexed Sequential, Tape Storage and Retrieval Methods Tape storage Devices, characteristics and limitations, Direct access Storage and Microcomputers – Hard Disks, Disk Cartridges, Direct Access Storage Devices for large Computer systems, Mass storage systems and Optical Disks, CD ROM.

Recommended Books:

1. "Computer Science: An Overview" by J. Glenn Brookshear
2. Computer Fundamentals, P. K. Sinha, BPB Publications, Sixth Edition.

BSCIT103(DSC)	Mathematics Foundation	4L:0T:0P	4 Credits

Course Objective: Provide a basic understanding of fundamental mathematical concepts such as sets, functions, matrix algebra, and discrete mathematics, enables the students to use mathematical models and techniques to analyze and understand problems in computer science.

Course Outcome: By the end of this course, students should be able to:

1. Understand sets, relations and functions.
2. To perform the operations associated with sets, functions and relations.
3. To introduce, counting and recurrence relations.

Course Content:

UNIT I: Set, Relation and Function

Set, Set Operations, Properties of Set operations, Subset, Venn Diagrams, Cartesian Products. Relations on a Set, Properties of Relations, Representing Relations using matrices and digraphs, Types of Relations, Equivalence Relation, Equivalence relation and partition on set, Closures of Relations, Warshall's algorithm.

Functions, properties of functions (domain, range), composition of functions, surjective (onto), injective (one-to-one) and bijective functions, inverse of functions.

Some useful functions for Computer Science: Exponential and Logarithmic functions, Polynomial functions, Ceiling and Floor functions.

UNIT II: Counting and Recurrence Relation

Basics of counting, Pigeonhole principle, permutation, combination, Binomial coefficients, Binomial theorem.

Recurrence relations, modelling recurrence relations with examples, like Fibonacci numbers, the tower of Hanoi problem. Solving linear recurrence relation with constant coefficients using characteristic equation roots method.

UNIT III: Elementary Graph Theory

Basic terminologies of graphs, connected and disconnected graphs, subgraph, paths and cycles, complete graphs, digraphs, weighted graphs, Euler and Hamiltonian graphs.

Trees, properties of trees, concept of spanning tree. Planar graphs. Definitions and basic results on the topics mentioned.

UNIT IV: Matrix Algebra

Types of matrices, algebra of matrices–addition, subtraction, and multiplication of matrices, determinant of a matrix, symmetric and skew-symmetric matrices, orthogonal matrix, rank of a matrix, inverse of a matrix, applications of matrices to solve system of linear equations, Eigen values and Eigen vectors, Caley-Hamilton theorem.

Text Books

1. Garg, Reena, Engineering Mathematics, Khanna Book Publishing Company, 2024. (AICTE Recommended Textbook)
2. Garg, Reena, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2023.
3. Kolman B., Busby R. and Ross S., Discrete Mathematical Structures, 6th Edition, Pearson Education, 2015.

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SEMESTER –II

BSCIT201(DSC)	Data Structures and Algorithms	3L:0T:2P	4 Credits

Course Objective: Understand the fundamental concepts of Data Structures and their applications. Develop problem-solving skills and implement Data Structures using C programming language.

Course Outcome: By the end of this course, students should be able to:

1. Understand concepts such as data organizations, need of data structures, types of data structure, algorithm complexity and time-space trade-off.
2. Understand and apply data structures such as stacks, queues, arrays and linked-list.
3. Understand the concept of different searching and sorting algorithms.

Course Content:

UNIT I:

Introduction and Overview: Definition, Classification and Operations of Data Structures. Algorithms: Complexity, Time-Space Tradeoff.

Arrays: Definition and Classification of Arrays, Representation of Linear Arrays in Memory, Operations on Linear Arrays: Traversing, Inserting, Deleting, Searching, Sorting and Merging. Searching: Linear Search and Binary Search, Comparison of Methods. Sorting: Bubble Sort, Selection Sort, and Insertion Sort. Two-Dimensional Arrays, Representation of Two-Dimensional Arrays in Memory, Matrices and Sparse Matrices, Multi-Dimensional Arrays.

UNIT II:

Linked Lists: Definition, Comparison with Arrays, Representation, Types of Linked lists, Traversing, Inserting, Deleting and Searching in Singly Linked List, Doubly Linked List and Circular Linked List. Applications of Linked Lists: Addition of Polynomials.

Hashing and Collision: Hashing, Hash Tables, Types of Hash Functions, Collision, Collision Resolution with Open Addressing and Chaining.

UNIT III:

Stacks: Definition, Representation of Stacks using Arrays and Linked List, Operations on Stacks using Arrays and Linked List, Application of Stacks: Arithmetic Expressions, Polish Notation, Conversion of Infix Expression to Postfix Expression, Evaluation of Postfix Expression.

Recursion: Definition, Recursive Notation, Runtime Stack, Applications of Recursion: Factorial of Number, GCD, Fibonacci Series and Towers of Hanoi.

Queues: Definition, Representation of Queues using Array and Linked List, Types of Queue: Simple Queue, Circular Queue, Double-Ended queue, Priority Queue, Operations on Simple Queues and Circular Queues using Array and Linked List, Applications of Queues.

UNIT IV:

Graphs: Definition, Terminology, Representation, Traversal.

Trees: Definition, Terminology, Binary Trees, Traversal of Binary Tree, Binary Search Tree, Inserting, Deleting and Searching in Binary Search Tree, Height Balanced Trees: AVL Trees, Insertion and Deletion in AVL Tree.

Text Books

1. R.B. Patel, “Expert Data Structures with C”, Khanna Book Publishing Company, 2023 (AICTE Recommended Textbook)
2. Seymour Lipschutz, “Data Structures with C”, Schaum’s Outlines, Tata McGraw-Hill, 2011.
3. Yashavant Kanetkar, "Data Structures Through C", 4th Edition, BPB Publications, 2022.

BSCIT202(DSC)	Object Oriented Programming using C++	3L:0T:2P	4 Credits

Course Objective:

1. The objective of this course is to introduce students to the principles and concepts of object-oriented programming using the C++ programming language.
2. The course aims to develop students' skills in designing and implementing object-oriented solutions to real-world problems.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamental concepts of object-oriented programming.
2. Design and implement C++ programs using classes, objects, and inheritance.
3. Apply polymorphism and templates to develop reusable code.
4. Utilize advanced features of C++ to develop efficient and modular programs.

Course Content/Syllabus:

Unit-1: Introduction to Object-Oriented Programming (OOP)

OOP concepts: Abstraction, Encapsulation, Inheritance, Polymorphism, Procedural Vs. Object- Oriented Programming, Principles of OOP and their benefits.

Unit-2: C++ Programming Basics

Program structure and basic syntax in C++, Namespaces, Identifiers, Variables, Constants, Enums, Operators and typecasting in C++.

Unit-3: Classes and Objects

Classes and Objects in C++, Access specifiers: Public, Private, Protected, Constructors and Destructors in classes.

Unit-4: Inheritance and Polymorphism

Concept of Inheritance and its types, Polymorphism and function overloading, Virtual functions and abstract classes.

Unit-5: Exception Handling and File I/O

Introduction to exception handling, try-catch blocks, Exception propagation, File input and output operations in C++.

Recommended Books:

1. "C++ Primer" by Stanley B. Lippman, Josée Lajoie, and Barbara E. Moo.
2. "Effective C++: 55 Specific Ways to Improve Your Programs and Designs" by Scott Meyers.

BSCIT203(DSC)	Computer System Architecture	4L:0T:0P	4 Credits

Course Objective: To Understand the basics of Digital Electronics and Binary Number System, implementation of Combinational Circuit. & Sequential Circuit. To Understand the Organization of Basic computers and concept of memory organization.

Course Outcome: By the end of this course, students should be able to:

- Design and simplify combinational and sequential circuits using basic building blocks.
- Represent data in binary form, convert numeric data between different number systems and perform arithmetic operations in binary.
- Explain instruction cycle, pipelining and interrupts.

Course Content/Syllabus:

UNIT-I

Digital Principles: Definition for Digital signals, Digital logic, Digital computers, Von Neumann Architecture, Boolean Laws and Theorems, K-Map: Truth Tables to K-Map, 2, 3 and 4 variable K Map, K-Map Simplifications, Don't Care Conditions, SOP and POS.

Number Systems: Decimal, Binary, Octal, Hexadecimal, Number System Conversions, Binary Arithmetic, Addition and subtraction of BCD, Octal Arithmetic, Hexadecimal Arithmetic, Binary Codes, Decimal Codes, Error detecting and correcting codes, ASCII, EBCDIC, Excess- 3 Code, The Gray Code.

UNIT-II

Combinational Circuits: Half Adder and Full Adder, Subtractor, Decoders, Encoder, Multiplexer, Demultiplexer

Sequential Circuits: Flip-Flops- SR Flip- Flop, D Flip-Flop, J-K Flip-Flop, T Flip-Flop.

Register: 4 bit register with parallel load, Shift Registers- Bidirectional shift register with parallel load

Binary Counters-4 bit synchronous and Asynchronous binary counter.

UNIT-III

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input- Output Interrupt, Complete Computer Description, Design of Basic Computer, Design of Accumulator logic. Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer(RISC), RISC Vs CISC.

UNIT-IV

Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline. Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt, Direct memory Access, Input-Output Processor(IOP).

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate

Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

Text Books:

1. Donald P Leach, Albert Paul Malvino, Goutam Saha- “Digital Principles & Applications” , Tata McGraw Hill Education Private Limited,2011Edition.
2. M. Morris Mano- “Computer System Architecture”, Pearson/Phi, Third Edition.

SEMESTER –III

BSCIT301(DSC)	Java Programming	3L:0T:2P	4 Credits

Course Objective:

1. To introduce the object-oriented programming system concepts.
2. To introduce syntax and semantics of Java programming language.
3. To develop modular programs using Java.
4. To setup JDK environment to create, debug and run Java programs.

Course Outcome: By the end of this course, students should be able to:

- Design and simplify combinational and sequential circuits using basic building blocks.
- Represent data in binary form, convert data between different number systems.
- Perform arithmetic operations in binary.
- Explain instruction cycle, pipelining and interrupts.

Course Content/Syllabus:

UNIT I:

Fundamentals of Object-Oriented Programming: Basic Concepts of Object-Oriented Programming (OOP), Benefits and Applications of OOP.

Java Evolution: Java Features, Difference between Java, C and C++, Java and Internet, Java Environment.

Overview of Java Language: Introduction to Simple Java Program, Use of Comments and Math function, Application of two classes, Java Program Structure, Java Tokens and statements, Implementing Java program and JVM, Command Line Arguments.

UNIT II:

Constants, Variables and Data Types: Constants, Variables, Data Types, Declaration of Variables, Giving values to Variables, Symbolic Constants, Typecasting.

Operators & Expressions: Arithmetic operators, Relational operators, Logical operators, Assignment operators, Increment & Decrement operators, conditional operators, Bitwise operators, Arithmetic Expressions, Evaluation of Expressions, Type Conversions in Expressions, Operator Precedence & Associativity.

Decision Making, Branching & Looping: Decision Making with Control Statements, Looping statements, Jump in loops, Labelled loops.

UNIT III:

Classes, Objects and Methods: Defining Class, Methods Declaration, Constructors, Methods Overloading, Overriding Methods, Inheritance

Arrays, Strings and Vectors: 1D arrays, Creating an Array, 2D arrays, Strings, Vectors, Wrapper Classes, Enumerated Types

Inheritance: Defining, extending classes, and Implementing Interfaces. Multiple Inheritance and polymorphism.

UNIT IV:

Packages: Basics of packages, System packages, Creating and accessing packages, Creating user defined packages, Adding class to a package.

Exception Handling: Using the main keywords of exception handling: try, catch, throw, throws and finally; Nested try, Multiple catch statements, Creating user defined exceptions

Text Books

1. Balagurusami E. (2023). Programming with JAVA: A Primer. 7th edition. India: McGraw Hill Education
2. Schildt, H. (2022). Java: The Complete Reference. 12th edition. McGraw-Hill Education

BSCIT302(DSC)	Database Management Systems	3L:0T:2P	4 Credits

Course Objective:

1. Understanding Core Concepts of DBMS.
2. Proficiency in Database Design and SQL.
3. Application of Advanced Database Techniques.

Course Outcome: By the end of this course, students should be able to:

1. Understand the basic principles of database management system.
2. Identify the data models for relative problem.
3. Apply SQL to find solutions to a broad range of queries.
4. Apply normalization techniques to improve database design.

Course Content/Syllabus:

UNIT I:

Introduction to Databases: Definition of Data, Database, and DBMS, Overview of Database Applications, Advantages and Disadvantages of DBMS, Roles of Database Users and Administrators

Data Models: Introduction to Data Models, Types of Data Models (Hierarchical, Network, Relational, Object-oriented), Importance of Data Models in DBMS

Database Design: Keys: Primary Key, Candidate Key, Super Key, Foreign Key, Composite Key, Alternate Key, Unique Key, Surrogate Key, Constraints in a table: Primary Key, Foreign Key,Unique Key, NOT NULL, CHECK, Entity-Relationship (ER) Model, Entities and Entity Sets, Attributes and Relationships, ER Diagrams, Key Constraints and Weak Entity Sets, Extended ER Features, Introduction to the Relational Model and Relational Schema

UNIT II:

Relational Algebra and Calculus: Introduction to Relational Algebra, Operations: Selection, Projection, Set Operations, Join Operations, Division, Tuple and Domain Relational Calculus

Structured Query Language (SQL): SQL Basics: DDL and DML, Aggregate Functions (Min(), Max(), Sum(), Avg(), Count()), Logical operators (AND, OR, NOT), Predicates (Like, Between, Alias, Distinct), Clauses(Group By, Having, Order by, top/limit), Inner Join, Natural Join, Full Outer Join, Left Outer Join, Right outer Join, Equi Join

Advanced SQL: Analytical queries, Hierarchical queries, Recursive queries, Views, Cursors, Stored Procedures and Functions, Packages, Triggers, Dynamic SQL

Normalization and Database Design: Functional Dependencies: Armstrong's Axioms, Definition, Properties (Reflexivity, Augmentation, Transitivity), Types (Trivial, Non-Trivial, Partial and Full Functional Dependency), Closure of Functional Dependencies, Normal Forms (1NF, 2NF, 3NF, BCNF), Denormalization.

UNIT III:

Transaction Management: ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control, Performance of Locking, Transaction Support in SQL, Introduction to Crash Recovery, 2PL, Serializability, and Recoverability, Introduction to Lock Management, Dealing with Deadlocks

Database Storage and Indexing: Data on External Storage, File Organizations and Indexing,

Index Data Structures, Comparison of File Organizations, Indexes and Performance Tuning, Guidelines for Index Selection, Basic Examples of Index Selection

UNIT IV:

NoSQL Databases and Big Data: Introduction to NoSQL, Data Models: Document, Key value, Column family, Graph. Uses and Features of NO/SQL document databases. CAP theorem, BASE vs ACID, CRUD operations, MongoDB operators, Overview of Big Data Technologies: Hadoop, MongoDB, Cassandra.

Database Security and Advanced Topics: Introduction to Database Security, Access Control, Discretionary Access Control, Introduction to Data Warehousing, OLAP, Data Mining

Text Books

1. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, third edition, McGraw – Hill, 2018
2. Benjamin Rosenzweig, Elena Rakhimov, “Oracle PL/SQL by Example”, fifth edition, Prentice Hall, 2015
3. Brad Dayley, “NoSQL with MongoDB in 24 Hours”, 1st edition, Sams Publishing, 2024

BSCIT303(DSC)	Operating Systems	4L:0T:0P	4 Credits

Course Objectives: Learn concepts of operating systems.,mechanisms of OS to handle processes and various mechanisms involved in memory management techniques.

Course Outcomes : At the end of the course, students will be able to:

1. Explain the fundamentals of the operating system.
2. Comprehend multithreaded programming, CPU scheduling, process management, process synchronization, memory, deadlocks, and storage management.
3. Compare the performance of CPU scheduling algorithms.
4. Identify the features of I/O and File handling methods.

Course Content/Syllabus:

UNIT I:

Operating Systems Overview: Definition, Evaluation of O.S, Components & Services of OS, Structure, Architecture, types of Operating Systems, Batch Systems, Concepts of Multiprogramming and Time Sharing, Parallel, Distributed and real time Systems.

Operating Systems Structures: Operating system services and systems calls, system programs, operating system structure, operating systems generations.

UNIT II:

Process Management: Process Definition, Process states, Process State transitions, Process Scheduling, Process Control Block, Threads, Concept of multithreads, Benefits of threads, Types of threads.

Process Scheduling: Definition, Scheduling objectives, Scheduling algorithms, CPU scheduling Preemptive and Non-preemptive Scheduling algorithms (FCFS, SJF and RR), Performance evaluation of the scheduling Algorithms

UNIT III:

Process Synchronization: Introduction, Inter-process Communication, Race Conditions, Critical Section Problem, Mutual Exclusion, Semaphores, Monitors.

Deadlocks: System model, deadlock characterization, deadlock prevention, avoidance, Banker's algorithm, Deadlock detection, and recovery from deadlocks.

UNIT IV:

Memory Management: Logical and Physical address map, Swapping, Memory allocation, MFT, MVT, Internal and External fragmentation and Compaction, Paging, Segmentation.

Virtual Memory: Demand paging, Page Replacement algorithms, Allocation of frames, thrashing.

I/O Management: Principles of I/O Hardware: Disk structure, Disk scheduling algorithms.

Text Books:

1. Ekta Walia, Operating Systems Concepts, Khanna Publishing House, 2022 (AICTE Recommended Textbook)
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2006), Operating System Principles, 7th edition OR Later edition, Wiley India Private Limited, New Delhi.

SEMESTER –IV

BSCIT401(DSC)	Python Programming	3L:0T:2P	4 Credits

Course Objective: Develop modular Python programs, apply suitable Python programming constructs, built-in data structures using Python libraries to solve a problem. And understand basic Data visualization and File handling in Python.

Course Outcome: At the end of the course, students will be able to:

1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Write simple Python programs using conditionals and loops for solving problems.
4. Decompose a Python program into functions.
5. Represent compound data using Python lists, tuples, dictionaries etc.
6. Read and write data from/to files in Python programs.

Course Content/Syllabus:

UNIT I:

Introduction: History and Application areas of Python; Structure of Python Program; Identifiers and Keywords; Operators and Precedence; Basic Data Types and type conversion;
Statements and expressions; Input/Output statements.

Strings: Creating and Storing Strings, Built-in functions for strings; string operators, String slicing and joining; Formatting Strings.

Control Flow Statements: Conditional Flow statements; Loop Control Statements; Nested control Flow; continue and break statements, continue, Pass and exit.

UNIT II:

Functions: Built-In Functions, Function Definition and call; Scope and Lifetime of Variables, Default Parameters, Command Line Arguments; Lambda Functions; Assert statement; Importing User defined module;

Mutable and Immutable objects: Lists, Tuples and Dictionaries; Commonly used Functions on Lists, Tuples and Dictionaries. Passing Lists, tuples and Dictionaries as arguments to functions. Using Math and Numpy module for list of integers and arrays.

UNIT III:

Files: Types of Files; Creating, Reading and writing on Text and Binary Files:The Pickle Module, Reading and Writing CSV Files. Reading and writing of csv and JSON files.

Exception Handling: Try-except-else-finally block, raise statement, hierarchy of exceptions, adding exceptions.

Data visualization: Plotting various 2D and 3D graphics; Histogram; Pi charts; Sine and cosine curves.

Text Books:

1. Venkatesh, Nagaraju Y, Introduction to Python Programming, Khanna Publishing House, 2021.
2. Jeeva Jose, Introduction to Computing & Problem Solving With PYTHON, Khanna Publishing House, 2023.
3. Sheetal Taneja & Naveen Kumar: Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications, Pearson, 2017.

BSCIT402(DSC)	Internet of Things	3L:0T:2P	4 Credits

Course Objective: Introducing the evolution of internet technology and the need for IoT.Train the students to build IoT systems using sensors, single board computers and apply IoT data for business solutions in various domains in a secured manner.

Course Outcome: At the end of the course, students will be able to:

1. Identify the IoT networking components with respect to the OSI layer.
2. Build schematic for IoT solutions.
3. Design and develop IoT based sensor systems.
4. Select IoT protocols and software.
5. Evaluate the wireless technologies for IoT.
6. Appreciate the need for IoT Trust and variants of IoT.

Course Content/Syllabus:

UNIT I:

Evolution of IoT

Review of computer communication concepts (OSI layers, components, packet communication, Networks, TCP-IP, subnetting, IPV4 addressing and challenges), IPV6 addressing, IoT architecture reference layer.

Introduction to IoT components

Characteristics IoT sensor nodes, Edge computer, cloud and peripheral cloud, single board computers, open source hardware, Examples of IoT infrastructure

UNIT II:

IoT protocols and software

MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, COAP, XMPP and gateway protocols

IoT point to point communication technologies

IoT Communication Pattern, IoT Protocol Architecture, Selection of Wireless technologies (6LoWPAN, Zigbee, WIFI, BT, BLE, SIG, NFC, LORA, LiFi, Widi)

UNIT III:

Introduction to Cloud computation and Big data analytics

Evolution of Cloud Computation, Commercial clouds and their features, open source IoT platforms, cloud dashboards, Introduction to big data analytics and Hadoop.

IoT security

Need for encryption, standard encryption protocol, lightweight cryptography, Quadruple Trust Model for IoT-A – Threat Analysis and model for IoT-A, Cloud security

UNIT IV:

IoT application and its Variants

Case studies: IoT for smart cities, health care, agriculture, smart meters, M2M, Web of things

Contemporary issues

Cellular IoT, Industrial IoT, Industry 4.0, IoT standards.

Text Book(s):

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian

Lange, Stefan Meissner, “Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model”, Springer Open, 2016
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, “From Machine to Machine to Internet of Things”, Elsevier Publications, 2014.

BSCIT403(DSC)	Design and Analysis of Algorithms	4L:0T:0P	4 Credits

Course Objective: This course envisions to impart to students the understanding of basic algorithm designing paradigms. This course expects to enable a student to synthesize efficient algorithms in common design situations and real-life problems.

Course Outcome: At the end of the course, students will be able to:

1. Evaluate the correctness and analyze complexity of algorithms.
2. Implement various algorithmic design techniques and solve classical problems.
3. Design solutions for real world problems by identifying, applying and implementing appropriate design techniques.
4. Design solutions for real world problems by reducing to classical problems.
5. Analyze the impact of various implementation choices on the algorithm complexity.

Course Content/Syllabus:

UNIT I:

What is an algorithm? Design and performance analysis of algorithms, time complexity, space complexity.

Asymptotic notations (O, Ω, Θ) to measure growth of a function and application to measure complexity of algorithms.

Analysis of sequential search, bubble sort, selection sort, insertion sort, matrix multiplication. Recursion: Basic concept. Analysis of recursive algorithms, Master's theorem.

UNIT II:

The Divide & Conquer Design Technique:

The general concept. Binary search, finding the maximum and minimum, merge sort, quick sort. best-case and worst-case analysis for the mentioned algorithms. Strassen's matrix multiplication.

Lower bound for comparison-based sorting.

The Greedy Design Technique:

The general concept. Applications to general Knapsack problem, finding minimum weight spanning trees: Prim's and Kruskal's algorithms, Dijkstra's algorithm for finding single source shortest paths problem.

UNIT III:

The Dynamic Programming Design Technique:

The general concept. Computation of Fibonacci series and Binomial coefficients, all pair shortest paths problem (Floyd-Warshall's algorithm), 0/1 Knapsack problem.

Algorithms on Graphs:

Breadth First Search, Depth First Search, finding connected components, depth first search of a directed graph, topological sorting.

UNIT IV:

Limitations of Algorithmic Power:

Backtracking Method: n-Queen problem; sum of subsets problem/ Hamiltonian circuit problem/vertex cover problem.

Computational Intractability: Overview of non-deterministic algorithms, P, NP, NP-Complete and NP-hard problems.

Text Books

1. Gajendra Sharma, Design and Analysis of Algorithms, Khanna Publishing House (AICTE Recommended Textbook)
2. Cormen Thomas H., Leiserson Charles E., Rivest Ronald L. and Stein Clifford, Introduction to Algorithms, PHI publication, 3rd Edition, 2009.

SEMESTER –V

BSCIT501(DSC)	Computer Networks	3L:0T:2P	4 Credits

Course Objectives: Understand the fundamental concepts of Computer Networks and their applications. Develop problem-solving skills related to network design, implementation, and troubleshooting.

Course Outcome: At the end of the course, students will be able to:

1. Explain basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP, networks devices and transmission media, Analog and digital data transmission.
2. Apply channel allocation, framing, error and flow control techniques.
3. Explain the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.

Course Content/Syllabus:

UNIT I: Introduction to Computer Networks

Overview of Computer Networks: Definition and Objectives, Applications and Examples Network Components and Architecture

Network Models: OSI Model: Layers and Functions, TCP/IP Model: Layers and Functions Comparison between OSI and TCP/IP Models

Network Topologies: Physical vs. Logical Topologies, Common Topologies: Star, Ring, Bus, Mesh, Hybrid, Advantages and Disadvantages of Each Topology

Data Transmission: Analog vs. Digital Signals, Transmission Modes: Simplex, Half-Duplex, Full-Duplex, Bandwidth and Latency

Networking Devices: Routers, Switches, Hubs, Bridges, Gateways, Functions and Configurations of Each Device.

UNIT II: Data Link Layer and Networking Protocols

Data Link Layer Fundamentals: Functions of the Data Link Layer, Framing, Error Detection, and Error Correction, Flow Control Mechanisms.

Ethernet: Ethernet Standards and Frame Structure, MAC Addressing and ARP, Ethernet Switching: Basic Concepts and Methods

Network Protocols: Introduction to TCP/IP Protocol Suite, IP Addressing: IPv4 and IPv6 Subnetting and CIDR Notation

Address Resolution Protocol (ARP): ARP Operation and Table, ARP Spoofing and Security Considerations

Virtual LANs (VLANs): Concept of VLANs, VLAN Tagging and Configuration, Benefits and Use Cases

UNIT III: Network Layer and Transport Layer

Network Layer: IP Routing: Static vs. Dynamic Routing, Routing Protocols: RIP, OSPF, BGP, Network Address Translation (NAT)

Transport Layer: TCP vs. UDP: Characteristics and Use Cases, TCP Handshake and Connection Management, Flow Control and Congestion Control in TCP

Congestion Control Algorithms: Techniques: Slow Start, Congestion Avoidance, Fast Retransmit, Fast Recovery, TCP Variants: TCP Reno, TCP Vegas.

Quality of Service (QoS): QoS Principles and Mechanisms, Differentiated Services (DiffServ) and Integrated Services (IntServ)

Network Security Fundamentals: Threats and Vulnerabilities, Basic Security Mechanisms: Firewalls, VPNs, Encryption

UNIT IV: Application Layer and Emerging Technologies

Application Layer Protocols: HTTP/HTTPS: Structure and Operation, FTP, SMTP, POP3, IMAP: Protocols and Uses, DNS: Domain Name System and Resolution

Network Applications: Web Browsing, Email Communication, File Transfer, Voice over IP (VoIP) and Streaming.

Emerging Technologies: Software-Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IoT) and Its Impact on Networking

Network Management: SNMP: Simple Network Management Protocol, Network Monitoring Tools and Techniques.

Future Trends in Networking: 5G and Beyond, Network Automation and Artificial Intelligence in Networking.

Text Books:

1. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education, 2011.
2. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson, 2021.

BSCIT502(DSC)	ARTIFICIAL INTELLIGENCE	3L:0T:2P	4 Credits

Course Objective:

1. The objective of this course is to provide students with an understanding of artificial intelligence and its various techniques and applications.
2. The course aims to develop students' skills in designing and implementing AI systems, solving AI problems, and exploring the ethical considerations of AI.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamental concepts and techniques of artificial intelligence.
2. Apply AI algorithms and methodologies to solve real-world problems.
3. Design and develop AI systems using appropriate tools and frameworks.
4. Evaluate and optimize AI models for performance and accuracy.
5. Recognize and analyze the ethical implications of AI technologies.

Course Content/Syllabus:

Unit 1: Introduction to Artificial Intelligence

Overview of artificial intelligence and its applications, History and foundations of AI, Ethical considerations in AI development and deployment

Unit 2: Problem Solving and Search Algorithms

Problem-solving techniques and algorithms, Search algorithms: uninformed and informed search, Heuristic search and optimization algorithms

Unit 3: Knowledge Representation and Reasoning

Knowledge representation techniques: logic, semantic networks, and frames, Inference mechanisms and reasoning algorithms, Uncertainty and probabilistic reasoning in AI

Unit 4: Machine Learning and AI Models

Introduction to machine learning algorithms, Supervised, unsupervised, and reinforcement learning, Deep learning and neural networks for AI applications

Unit 5: AI Systems and Applications

Natural language processing and understanding, Computer vision and image recognition, AI in robotics and autonomous systems

Recommended Books:

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
2. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy.

BSCIT503(DSC)	Software Engineering	4L:0T:0P	4 Credits

Course Objective: To Acquire a comprehensive understanding of the software development lifecycle and its application in contemporary software engineering practices.

Course Outcome: At the end of the course, students will be able to:

1. Students will be able to decompose the given project in various phases of a lifecycle.
2. Students will be able to choose appropriate process model depending on the user requirements.
3. Students will be able perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
4. Students can apply the knowledge, techniques, and skills in the development of a software product.

Course Content/Syllabus:

UNIT I:

The evolving role of software, changing nature of software, layered technology, a process framework, Process models: The waterfall model, incremental process models, evolutionary process models, the unified process.

Agile software development: Agility Principles, Agile methods, Plan-driven and agile development, Extreme programming, Scrum, A Tool Set for the Agile Process.

UNIT II:

Software Requirements Engineering: Functional and non-functional requirements, the software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

Risk management: Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM, RMMM plan.

Project planning- Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques.

UNIT III:

Design: Design process and design quality, design concepts, the design model, software architecture, data design, architectural design, Basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging.

Product metrics: Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.

UNIT IV:

Quality Management: Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability.

Release Management: Release planning, development and build plans, release strategies, risk management, and post-deployment monitoring.

Product sustenance: Maintenance, updates, End of life, migration strategies.

Text Books

1. Software Engineering, N.S. Gill, Khanna Publishing House, 2023 (AICTE Recommended Textbook)
2. Software Engineering, Ian Somerville, 9th edition, Pearson education.

3. Software Engineering A practitioner's Approach, 8th edition, Roger S Pressman, Bruce R. Maxim. McGraw Hill Education, 2015.

SEMESTER –VI

BSCIT601(DSC)	Data Analytics with R	3L:0T:2P	4 Credits

Course Objective:

1. In this course students will learn R. Programming language, data analytics, data visualization and statistical model for data analytics.
2. By completion of this course, students will be able to become data analyst.

Course Outcome: At the end of the course, students will be able to:

1. Students will be able to decompose the given project in various phases of a lifecycle.
2. Students will be able to choose appropriate process model depending on the user requirements.
3. Students will be able perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
4. Students will be able to know various processes used in all the phases of the product.
5. Students can apply the knowledge, techniques, and skills in the development of a software product.

Course Content/Syllabus:

Unit 1. **Introduction to Statistical Methods**
Statistics & Managerial Decisions, Statistical Data, Operation Research Techniques

Unit 2. **Data Collection And Analysis**
Collection and presentation of data in terms of tables, graphs, raw data, frequency distributions, histogram etc. Cumulative frequency curve, Measures of central tendency and location, Partition values, Comparison of various measures of central tendencies, Measures of dispersion, skewness
& kurtosis, comparison of various measures of dispersion

Unit 3. **Probability Distribution & Statistics**
Introduction of Probability, sample, space & events, Basic rules of probability, permutation & combinations, conditional probability, Bayes' theorem, distributions: Binomial, Poisson, Exponential and Normal distribution with their properties and application. Random variables –
discrete and continuous probability distribution functions

Unit 4. **Correlation And Regression Analysis**
Curve fitting, correlation and regression analysis, Autocorrelation, Multiple regression, statistical Inference & estimation applied to Industrial problems

Unit 5. **Understanding Data for Exploratory Analysis**
Exploratory data analysis and data visualization, Perception, Continuous variables, Discrete variables, Dependency relationships, Multivariate categorical variables, Temporal data, Spatial data
Data Science Pipeline: Collect, Import, Clean, Transform, Visualize, Model, Communicate

Unit 6. **Statistical Tests and Testing of Hypothesis**
Elementary theory and practice of sampling, standard error or means and variance, tests of significance, T test, F test, Z test and chi-square test along with their applications, Goodness of fit, testing of hypotheses and decision
making, analysis of variance (ANOVA)

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Recommended Books:

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. Version3.0.1 (2013-05-16). URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

BSCIT602(DSC)	Android Programming	3L:0T:2P	4 Credits

Course Objective:

1. The objective of this course is to provide students with the knowledge and skills required to develop Android applications.
2. The course aims to develop students' proficiency in Android app development, user interface design, and integration of device features.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of Android application development.
2. Design and implement user-friendly Android applications with intuitive user interfaces.
3. Integrate device features and services into Android applications.
4. Apply best practices for app deployment, testing, and maintenance.
5. Develop real-world Android applications and deploy them to app stores.

Course Content/Syllabus:

Unit 1: Introduction to Android Development

Overview of Android platform and its architecture, Setting up the Android development environment, Basics of Java programming for Android

Unit 2: User Interface Design for Android Apps

Android layout components: views, view groups, and XML layout files, UI design principles and best practices, Handling user input and events in Android

Unit 3: Android App Components

Activities, services, and broadcast receivers, Intents and intent filters for inter-component communication, Working with fragments for flexible UI designs

Unit 4: Data Storage and Networking

Storing data in local databases using SQLite, Consuming web services and APIs in Android, Asynchronous programming and background tasks

Unit 5: Advanced Android Development Topics

Working with multimedia and sensors, Location-based services and Google Maps integration, App deployment, testing, and performance optimization

Recommended Books:

1. "Android Programming: The Big Nerd Ranch Guide" by Bill Phillips and Chris Stewart.
2. "Head First Android Development" by Dawn Griffiths and David Griffiths.

BSCIT603(DSC)	Cloud Computing	4L:0T:0P	4 Credits

Course Objective:
The objective of this course is to provide graduate students with the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture and applications by introducing and researching state-of-the-art in Cloud Computing fundamental issues, technologies, applications and implementations.
Course Outcome: By the end of this course, students should be able to:

1. Understand the key dimensions of the challenges and benefits of Cloud Computing.
2. Describe the principles of Parallel and Distributed Computing and evolution of cloud computing from existing technologies
3. Implement different types of Virtualization technologies and Service Oriented Architecture systems.
4. Choose among various cloud technologies for implementing applications.
5. Install and use current cloud technologies.

Course Content/Syllabus:

Unit 1 Introduction to Cloud Computing

Introduction: Cloud-definition, benefits, usage scenarios, History of Cloud Computing, Cloud Architecture, Types of Clouds, Players in Cloud Computing, issues in Clouds

Unit 2 Types of Cloud Services and Providers

Types of Cloud services, Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service, Monitoring as a Service, Communication as services. Service Providers- Google, Amazon, Microsoft Azure, IBM, Sales force.

Unit 3 Collaborating Using Cloud Services

Collaborating Using Cloud Services Email Communication over the Cloud, CRM Management, Project Management, Event Management, Task Management, Calendar, Schedules, Word Processing, Presentation, Spreadsheet, Databases, Desktop, Social Networks and Groupware

Unit 4 Virtualization for Cloud and Cloud Security

Virtualization for Cloud Need for Virtualization, Pros and cons of Virtualization, Types of Virtualizations, System VM, Process VM, Virtual Machine monitor, Virtual machine properties, HLL VM, Hypervisors, Xen, KVM, VMWare, Virtual Box, Hyper-V

Unit 5 Future Trends in Mobile Communication

Cloud Security: Infrastructure Security- Network level security, Host level security, Application-level security, Data security, Authentication in cloud computing, Cloud security challenges**.**

Recommended Books:

2. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood
3. "Cloud Computing: A Practical Approach" by Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter

SEMESTER –VII

BSCIT701(DSC)	**Machine Learning**	**3L:0T:2P**	**4 Credits**

Course Objective:

1. To understand the basic theory underlying machine learning.
2. To be able to formulate machine learning problems corresponding to different applications.
3. To understand a range of machine learning algorithms along with their strengths and weaknesses.
4. To be able to apply machine learning algorithms to solve problems of moderate complexity.
5. To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Course Outcome: By the end of this course, students should be able to:

1. Appreciate the importance of visualization in the data analytics solution.
2. Apply structured thinking to unstructured problems.
3. Understand a very broad collection of machine learning algorithms and problems.
4. Learn algorithmic topics of machine learning and mathematically deep enough to introduce the required theory.
5. Develop an appreciation for what is involved in learning from data.

Prerequisites: Basic knowledge of statistics and probability. Familiarity with fundamental programming concepts and proficiency in Python.

Course Content/Syllabus:

UNIT I: Introduction to Machine Learning

Introduction: Definition, History and Application of Machine Learning, *Types of Machine Learning*: Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning. Labeled and Unlabelled Dataset. *Supervised Learning Tasks*: Regression vs. Classification, *Learning Framework*: Training, Validation and Testing of ML models. *Performance Evaluation Parameters*: Confusion matrix, Accuracy, Precision, Recall, F1 Score, and AUC.

UNIT II: Supervised Learning and Unsupervised Learning

Regression: Linear and non-linear Regression, Logistic Regression. *Classification*: Naïve Bayes, K-Nearest Neighbors, Decision Trees. *Linear model*: Introduction to Artificial Neural Networks, Perceptron Learning Algorithm, Single Layer Perceptron, Introduction to Support Vector Machine for linearly separable data. *Clustering*: K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures. *ML Applications:* Ethical Considerations in Machine Learning, Case study and Real-world Applications.

Text Books:

1. Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House.
2. Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House.
3. Mitchell T. (1997). Machine Learning, First Edition, McGraw-Hill.
4. Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN9780323917780

SEMESTER –VIII

BSCIT801(DSC)	Deep Learning	3L:0T:2P	4 Credits

Course Objective:

1. The objective of this course is to provide students with an in-depth understanding of deep learning principles, algorithms, and applications.
2. The course aims to develop students' skills in designing and implementing deep neural networks for solving complex machine learning tasks.

Course Outcome: By the end of this course, students should be able to:

1. Understand the principles and architectures of deep neural networks.
2. Implement and train deep neural networks using appropriate frameworks and libraries.
3. Apply deep learning techniques to solve real-world problems in various domains.
4. Evaluate and optimize deep learning models for performance and accuracy.
5. Stay updated with the latest advancements and trends in deep learning research.

Course Content/Syllabus:

Unit 1: Introduction to Deep Learning

Overview of deep learning concepts and its significance, Basics of neural networks and gradient-based optimization, Activation functions and loss functions in deep learning

Unit 2: Deep Neural Network Architectures

Feedforward neural networks and backpropagation algorithm, Convolutional neural networks (CNNs) for image processing, Recurrent neural networks (RNNs) for sequential data analysis

Unit 3: Deep Learning Frameworks and Libraries

Introduction to popular deep learning frameworks (e.g., TensorFlow, PyTorch), Building and training deep neural networks using frameworks, Transfer learning and pre-trained models

Unit 4: Advanced Deep Learning Techniques

Generative adversarial networks (GANs) for data generation, Autoencoders and variational autoencoders (VAEs), Reinforcement learning with deep neural networks

Unit 5: Applications of Deep Learning

Deep learning for image classification and object detection, Natural language processing and sentiment analysis with deep learning, Deep learning in recommendation systems and autonomous vehicles

Recommended Books:

1. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
2. "Deep Learning with Python" by Francois Chollet.

Proposed Streams with Discipline-Specific Electives (DSE)

Note: The following is indicative. Universities/Institutes may add streams / electives as per their specific requirements.

S.NO.	Course Code	Semester	Professional Elective
1.	BSC-CS/BSC-IT-DSE001	III	Web Technology/ System Administrator
2.	BSC-CS/BSC-IT-DSE002	III	Multimedia Technology/ Management Information System
3.	BSC-CS/BSC-IT-DSE003	IV	Informatics Cyber laws
4.	BSC-CS/BSC-IT-DSE004	V	E-Commerce
5.	BSC-CS/BSC-IT-DSE005	VI	Social Network Analysis/ Optimization of ML
6.	BSC-CS/BSC-IT-DSE006	VII	Natural Language Processing
7.	BSC-CS/BSC-IT-DSE007	VII	Unix & shell Programming
8.	BSC-CS/BSC-IT-DSE008	VII	Basics of Data Analytics using Spreadsheet
9.	BSC-CS/BSC-IT-DSE009	VII	Network Security
10.	BSC-CS/BSC-IT-DSE010	VIII	Data mining
11.	BSC-CS/BSC-IT-DSE011	VIII	Block Chain Technology
12.	BSC-CS/BSC-IT-DSE012	VIII	Mobile Computing
13.	BSC-CS/BSC-IT-DSE013	VIII	Fundamental of Data Science

BSC-CS/BSC-IT-DSE001-A	Web Technologies	3L:0T:2P	4Credits

Course Objectives

CO1: To understand the concepts and architecture of the World Wide Web, Markup languages along with Cascading Style Sheets.

CO2: To understand the concepts of event handling and data validation mechanisms.

CO3: To understand the concepts of embedded dynamic scripting on client and server side Internet Programming and basic full stack web development.

CO4: To develop modern interactive web applications

Course Content:

Unit I:

Introduction to HTML, history of HTML, Objective, basic Structures of HTML, Header Tags, body tags, Paragraph Tags
Tags for FORM Creation, TABLE, FORM, TEXTAREA, SELECT, IMG, IFRAME FIELDSET, ANCHOR.
Lists in HTML, Introduction to DIV tag, NAVBAR Design.
Introduction to CSS, types, Selectors, and Responsiveness of a web page.
Introduction to Bootstrap, downloads/linking, using classes of Bootstrap, understanding the Grid System in Bootstrap.
Introduction to www, Protocols and Programs, Applications and development tools, web browsers, DNS, Web hosting Provider, Setting up of Windows/Linux/Unix web servers, Web hosting in cloud, Types of Web Hosting.

Unit II:

Introduction to JavaScript: Functions and Events, Document Object model traversing using JavaScript. Output System in JavaScript i.e. Alert, throughput, Input box, Console. Variables and Arrays in JavaScript.Date and String handling in JavaScript.
Manipulating CSS through JavaScript: Form Validation like Required validator, length validator, Pattern validator. Advanced JavaScript, Combining HTML, CSS and JavaScript events and buttons, controlling your browser.Introduction to AJAX, Purpose, advantages and disadvantages, AJAX based Web applications and alternatives of AJAX.
Introduction to XML: uses, Key concepts, DTD 8 schemas, XSL, XSLT,and XSL Elements and transforming with XSLT. Introduction to XHTML.
JSON: Introduction to JSON, Keys and Values, Types of Values, Arrays, Objects

Recommended Books:

1. Laura Lemay, Mastering HTML, CSS & Java Script Web Publishing, BPB Publications, 2016
2. Thomas A. Powell, The Complete Reference HTML & CSS, Fifth Edition, 2017

BSC-CS/BSC-IT-DSE001-B	System Administrator	3L:0T:2P	4 Credits

Course Objective: The objective of this course is to provide students with the knowledge and skills required to perform system administration tasks in various operating system environments. The course aims to develop students' understanding of system configuration, maintenance, security, and troubleshooting.

Course Outcome: By the end of this course, students should be able to:

1. Understand the roles and responsibilities of a system administrator.
2. Configure and manage operating system environments.
3. Implement security measures to protect system resources.
4. Perform system maintenance and troubleshooting tasks.
5. Apply best practices for system administration in different operating systems.

Course Content:

Unit-1: Introduction to System Administration

Role and responsibilities of a system administrator, Operating systems and their management, User and group management.

Unit-2: System Configuration and Maintenance

Installation and configuration of software and services, System updates and patch management, Disk management and file system maintenance.

Unit-3: Network Administration

Network configuration and troubleshooting, Firewall and network security, Remote access and VPN setup.

Unit-4: System Backup and Recovery

Data backup strategies and tools, Disaster recovery planning and implementation, System monitoring and performance tuning.

Unit-5: Cloud Computing and Virtualization

Introduction to cloud computing, Virtualization technologies (e.g., VMware, Hyper-V), Cloud services and their administration.

Recommended Books:

1. "UNIX and Linux System Administration Handbook" by Evi Nemeth, Garth Snyder, Trent R. Hein, and Ben Whaley.
2. "Windows Server Administration Fundamentals" by Microsoft Official Academic Course.

BSC-CS/BSC-IT-DSE002-A	Web Technologies	3L:0T:2P	4Credits

Course Objective: The objective of this course is to provide students with an understanding of multimedia technology and its applications in various domains. The course aims to develop students' skills in designing and developing multimedia content, integrating multimedia elements, and applying multimedia technologies.

Course Outcome: By the end of this course, students should be able to:

1. Understand the concepts and components of multimedia technology.
2. Design and develop multimedia content using appropriate tools and techniques.
3. Integrate various multimedia elements such as text, images, audio, and video.
4. Apply multimedia technologies in interactive applications and presentations.
5. Evaluate and optimize multimedia content for different platforms and devices.

Course Content:

Unit 1: Introduction to Multimedia Technology

Overview of multimedia technology and its components, Multimedia elements: text, images, audio, video, Multimedia file formats and compression techniques

Unit 2: Multimedia Authoring Tools and Techniques

Multimedia authoring software and tools, Design principles for multimedia content, Multimedia scripting and programming languages

Unit 3: Image and Video Processing in Multimedia

Image and video acquisition and editing, Image and video compression techniques, Image and video enhancement and effects

Unit 4: Audio and Animation in Multimedia

Digital audio concepts and formats, Audio editing and processing techniques, Animation principles and techniques

Unit 5: Multimedia Integration and Application Development

Integration of multimedia elements in interactive applications, Multimedia in web design and development, Optimization and delivery of multimedia content

Recommended Books:

1. "Multimedia: Making It Work" by Tay Vaughan.
2. "Multimedia Systems: Algorithms, Standards, and Industry Practices" by Parag Havaldar and Gerard Medioni.

BSC-CS/BSC-IT-DSE002-B	Management Information System	4L:0T:0P	4Credits

Course Objective: The objective of this course is to provide students with an understanding of management information systems and their role in organizations. The course aims to develop students' skills in designing and managing information systems to support business operations and decision-making.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamental concepts of management information systems.
2. Analyze business requirements and design effective information systems.
3. Evaluate and select appropriate technologies for information system implementation.
4. Apply information systems principles to support business operations and decision-making.
5. Understand the ethical and security considerations in managing information systems.\

Course Content:

Unit-1: Introduction to Management Information System

Definition and scope of Management Information System (MIS), Components and characteristics of MIS, Role of MIS in decision-making, Types of Information Systems: TPS, DSS, EIS, ERP, etc.

Unit-2: Information Technology and Business Processes

Business processes and their analysis, Business process reengineering and automation, Information Technology infrastructure for MIS.

Unit-3: Database and Data Management

Database concepts and design, Data modeling and normalization, Data storage, retrieval, and security.

Unit-4: Decision Support Systems and Business Intelligence

Introduction to Decision Support Systems (DSS), Data Warehousing and Data Mining, Business Intelligence tools and analytics.

Unit-5: Enterprise Systems and IT Governance

Enterprise Resource Planning (ERP) systems, IT governance and control mechanisms, Challenges and ethical issues in MIS.

Recommended Books:

1. "Management Information Systems: Managing the Digital Firm" by Kenneth C. Laudon and Jane P. Laudon.
2. "Information Systems Today: Managing in the Digital World" by Joseph Valacich, Christoph Schneider, and Robert M. Pearlson.

BSC-CS/BSC-IT-DSE003	Informatics Cyber laws	4L:0T:0P	4Credits

Course Objective: The objective of this course is to provide students with an understanding of cyber laws and their implications in the field of informatics. The course aims to develop students' knowledge of legal frameworks, ethical considerations, and security measures related to information technology.

Course Outcome: By the end of this course, students should be able to:

1. Understand the legal frameworks and regulations governing cyberspace.
2. Identify and analyse legal issues related to information technology.
3. Evaluate the ethical implications of information technology practices.
4. Apply security measures to protect information systems and data.
5. Develop an understanding of the legal rights and responsibilities of individuals and organizations in cyberspace.

Course Content:

Unit-1: Introduction to Informatics Cyber laws

Overview of Cyber laws and their significance, Types of Cybercrimes and legal implications, Jurisdiction and challenges in Cyber law enforcement.

Unit-2: Cyber Security and Data Privacy

Cyber security threats and countermeasures, Data protection laws and regulations, Cybersecurity policies and practices.

Unit-3: Legal Framework for E-commerce and Intellectual Property

Laws related to e-commerce and electronic transactions, Intellectual Property laws and their application in the digital environment.

Unit-4: Privacy and Data Protection Laws

Privacy laws and regulations, Data breach notification and handling, GDPR and other global data protection laws.

Unit-5: Cyber Crime Investigation and Digital Forensics

Digital evidence and forensic techniques, Cybercrime investigation process, Role of digital forensics in legal proceedings.

Recommended Books:

1. "Cyber Law: Legal and Practical Considerations for Computer, E-commerce, and Intellectual Property" by Brett J. Trout.
2. "Cyberlaw: Management and Entrepreneurship" by Patricia L. Bellia, Paul Schiff Berman, and David G. Post.

BSC-CS/BSC-IT-DSE004	E-Commerce	4L:0T:0P	4Credits

Course Objective: The objective of this course is to provide students with an understanding of e-commerce principles, technologies, and strategies. The course aims to develop students' skills in designing, developing, and managing e-commerce systems for online business operations.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of e-commerce and its impact on business.
2. Analyze and evaluate different e-commerce models and technologies.
3. Design and develop e-commerce websites and applications.
4. Apply security and privacy measures in e-commerce systems.
5. Understand the legal and ethical considerations in e-commerce.

Course Content:

Unit-1: Introduction to E-Commerce

Types of E-Commerce, E-Commerce business models. E-Commerce Framework

Unit-2: E-Commerce Infrastructure and Payment Systems

Electronic payment systems and security, Mobile payment and digital wallets.

Unit-3: E-Commerce Website Development

Building E-Commerce websites, Product catalogue management and online shopping cart, Customer registration and authentication.

Unit-4: E-Commerce Security and Legal Issues

Web security in E-Commerce, Legal and regulatory issues in E-Commerce, Consumer protection and privacy.

Unit-5: E-Commerce Marketing and Emerging Trends

E-Commerce marketing strategies, Social media and E-Commerce, Emerging trends in E- Commerce.

Recommended Books:

1. "E-Commerce 2021" by Kenneth C. Laudon and Carol Traver.
2. "E-Commerce: Business, Technology, Society" by Kenneth C. Laudon and Carol Guercio Traver.

BSC-CS/BSC-IT-DSE005-A	Social Network Analysis	4L:0T:0P	4Credits

COURSE OBJECTIVES

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To understand human behavior in social web and related communities.
- To learn visualization of social networks.

Course Content:

Unit-I: INTRODUCTION

Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Social Network analysis: Development of Social Network Analysis – Key concepts and measures in network analysis – Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Web-based networks – Applications of Social Network Analysis.

Unit-II: MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modelling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.

Unit-III: EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS

communities in social networks – Definition of community – Evaluating communities – Methods for community detection and mining – Applications of community mining algorithms – Tools for detecting communities social network infrastructures and communities – Decentralized online social networks – Multi-Relational characterization of dynamic social network communities.

Unit-IV: PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES

Understanding and predicting human behavior for social communities – User data management – Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust and reputation – Trust derivation based on trust comparisons – Attack spectrum and counter measures.

Unit-V: VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS

Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications –
Cover networks – Community welfare – Collaboration networks – Co-Citation networks.

Recommended Books:

1. Guandong Xu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo,-Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet

BSC-CS/BSC-IT-DSE005-B	Optimization of ML	4L:0T:0P	4Credits

Course Objectives:

Most problems arising in modern Machine Learning and Data Science are formulated as optimization programs. The most efficiently tractable subclass of these problems is the family of convex programs. The course will consist of two parts:

1) Convex Optimization (CO),
2) Application of the CO machinery in Data Science.

Course Outcomes:

Upon successful completion of the course the students will

1) Understand the theory and methodology of CO,
2) Be familiar with the most efficient and commonly used optimization techniques and advantages of their usage,
3) Will learn about numerous practical applications of the CO to modern statistical and machine learning problems,
4) Will be able to design and apply CO techniques themselves.

Course Content:

Unit I

Convex Optimization. The first part of the course focuses on defining, analyzing, and solving convex optimization problems that arise in applications. We will cover Convex sets, functions, and programs and their properties, Basics of convex analysis, cones, Linear, quadratic, and semi definite programming.

Unit II

Optimality conditions, introduction to duality theory, theorems of alternatives, Algorithms: Unconstrained minimization, Descent methods, Newton's method, Interior-point methods.

Unit III

Applications. Applications of the CO machinery to Statistics, Machine learning, and Data Science problems. Maximum likelihood and elements of Robust Statistics, Regularization: ridge regression, LASSO, and their analysis.

Unit IV

Elements of Bayesian Statistics, SVD, Matrix Norms, Robust Principal Component Analysis, Matrix completion, Examples from big data , engineering, and machine learning.

Unit V

Unconstrained Optimization, Optimality conditions. Convexity. Descent directions. Line search. Acceptability of step sizes. General minimization algorithm. Gradient method. Rate of convergence. Newton's method. Factorizations to ensure convergence. Weighted least squares. Introduction to AMPL. The Neso solver site.

Text Books:

Recommended Books:

1. Nesterov. Introductory Lectures on Convex Optimization: A Basic Course. Kluwer-Academic. 2003
2. Boyd & Vandenberghe. Convex Optimization. Cambridge University Press. 2003
3. Sra, Nowozin, Wright (eds). Optimization for Machine Learning. MIT Press. 2011

BSC-CS/BSC-IT-DSE006	Natural Language Processing	4L:0T:0P	4Credits

Course Objective: The objective of this course is to provide students with a comprehensive understanding of natural language processing (NLP) techniques and applications. The course aims to develop students' skills in processing and analyzing human language data, building language models, and developing NLP applications.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of natural language processing and its applications.
2. Process and analyze textual data using NLP techniques.
3. Build and evaluate language models for various NLP tasks.
4. Develop NLP applications such as sentiment analysis, text classification, and named entity recognition.
5. Stay updated with the latest advancements and research in natural language processing.

Course Content:

Unit 1: Introduction to Natural Language Processing

Overview of natural language processing and its significance, Basics of text pre-processing and tokenization, Language modelling and probability theory in NLP

Unit 2: Text Representation and Information Extraction

Feature extraction techniques for text data, Text normalization and stemming, Named entity recognition and entity linking

Unit 3: Sentiment Analysis and Text Classification

Sentiment analysis techniques for opinion mining, Text classification algorithms and evaluation metrics, Document clustering and topic modeling

Unit 4: Language Generation and Machine Translation

Language generation techniques: text summarization, paraphrasing, Machine translation and language modeling, Neural machine translation models

Unit 5: Advanced Topics in Natural Language Processing

Question answering and information retrieval, Dialogue systems and conversational agents, Neural network architectures for NLP tasks

Recommended Books:

1. "Speech and Language Processing" by Daniel Jurafsky and James H. Martin.
2. "Natural Language Processing with Python" by Steven Bird, Ewan Klein, and Edward Loper.

BSC-CS/BSC-IT-DSE007	Unix & Shell Programming	2L:0T:4P	4Credits

Course Objective: The objective of this course is to provide students with the knowledge and skills required to develop shell scripts and automate system administration tasks. The course aims to develop students' proficiency in shell programming, command-line tools, and system scripting.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of shell scripting and command-line interfaces.
2. Develop shell scripts to automate routine system administration tasks.
3. Utilize command-line tools and utilities for efficient system management.
4. Apply shell programming techniques to manipulate and process text files.
5. Solve complex problems using shell scripting and system automation.

Course Content:

Unit 1: Introduction to Shell Programming

Overview of shell scripting and its applications, Shell script execution and environment variables, Shell scripting basics: variables, control structures, and functions

Unit 2: File and Text Processing with Shell

File and directory manipulation using shell commands, Text processing and pattern matching with regular expressions, Shell pipelines and input/output redirection

Unit 3: System Administration and Automation

System monitoring and resource management, Process control and job scheduling, Error handling and logging in shell scripts

Unit 4: Shell Scripting for Networking and Security

Network configuration and management with shell scripts, User and group management, Shell scripting for system security and hardening

Unit 5: Advanced Shell Programming Techniques

Shell scripting for system backups and recovery, Scripting with advanced tools and utilities (e.g., awk, sed), Script debugging and optimization

Recommended Books:

1. "Learning the bash Shell: Unix Shell Programming" by Cameron Newham and Bill Rosenblatt.
2. "The Linux Command Line: A Complete Introduction" by William E. Shotts Jr.

BSC-CS/BSC-IT-DSE008	Basics of Data Analytics using Spreadsheet	3L:0T:2P	4 Credits

Course Objectives

1. Understand the basics of data analytics and its applications.
2. Develop proficiency in using spreadsheet software for data manipulation and analysis.
3. Build and use spreadsheet models for decision making & Communicate data insights effectively

Course Content:

UNIT I: Introduction to Data Analytics

Understanding data and its types (structured, unstructured, semi-structured)-What is Data Analytics- Types of data Analytics-Importance of Data Analytics- Applications of Data Analytics.

UNIT II: Data, Ethics, and Industry: Case Studies

Data Collection Methods - Different Data Sources & format - Data Cleaning and Transformation - Handling Missing Data and Outliers. - Ethical considerations in data analytics. - Real-world Applications of Data Analytics- Industry-specific applications (finance, marketing, operations) - Case Study

Recommended Books:

1. "Beginner's Guide for Data Analysis using R Programming" by Jeeva Jose, Khanna Publishing House, 2024.
2. "Data Analytics" by V.K. Jain, Khanna Book Publishing Company, 2024.
3. "Excel Data Analysis For Dummies" by Stephen L. Nelson and E. C. Nelson, John Wiley & Sons; 3rd edition, 2016
4. "Data Analysis Using Microsoft Excel" by Michael R. Middleton, Thomson, Brooks/Cole, 3rd edition , 2004

BSC-CS/BSC-IT-DSE009	NETWORK SECURITY	3L:0T:2P	4 Credits

Course objectives:

1. Understand the basics of Cryptography concepts, Security and its principle, to analyses different Cryptographic Algorithms and illustrate public and private key cryptography.To understand approaches and techniques to build protection mechanism in order to secure computer networks

Course outcome

At the end of the course, the student will be able to :

- Explain the basic concepts of Cryptography and Security aspects
- Apply different Cryptographic Algorithms for different applications
- Analyze different methods for authentication and access control.
- Describe key management, key distribution and Certificates.
- Explain about Electronic mail and IP Security.

Course Content:

UNIT I:

A model for Network Security, Classical encryption techniques: Symmetric cipher model, Substitution ciphers-Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One time pad, Steganography.

Block Ciphers and Data Encryption Standards: Traditional Block Cipher structures, data Encryption Standard (DES), A DES Example, The strength of DES, Block cipher design principles.

UNIT II:

Pseudorandom number Generators: Linear Congruential Generators, Blum Blum Shub Generator.

Public key cryptography and RSA: Principles of public key cryptosystems-Public key cryptosystems, Applications for public key cryptosystems, Requirements for public key cryptography, Public key Cryptanalysis, The RSA algorithm: Description of the Algorithm, Computational aspects, The Security of RSA.

Diffie-Hellman key exchange: The Algorithm, Key exchange Protocols, Man-in-the-middle Attack, Elliptic Curve Cryptography: Analog of Diffie-Hellman key Exchange, Elliptic Curve Encryption/Decryption, Security of Elliptic Curve Cryptography.

UNIT III:

Applications of Cryptographic Hash functions, Two simple Hash functions, Key management and distribution: Symmetric key distribution using symmetric encryption, Symmetric key distribution using asymmetric encryption, Distribution of public keys, X.509 Certificates, Public Key Infrastructures

UNIT IV:

User Authentication: Remote user authentication principles**,** Kerberos**,** Remote user authentication using asymmetric encryption.Web security consideration, Transport layer security.Email Threats and comprehensive email security, S/MIME, Pretty Good Privacy.

UNIT V:

Domainkeys Identified Mail.IP Security: IP Security overview, IP Security Policy, Encapsulating Security Payload, Combining security associations, Internet key exchange.

BSC-CS/BSC-IT-DSE010	Data Mining	3L:0T:2P	4 Credits

Course Content:

UNIT I:Data Mining:

Data, Information and Knowledge, Attribute Types, Introduction to Data Preprocessing, Data Cleaning, Data integration, data reduction, transformation and Data Discretization. Measuring the Central Tendency: Basics of Mean, Median, and Mode, Measuring the Dispersion of Data, Variance and Standard Deviation. Measuring Data Similarity and Dissimilarity, Data Matrix versus Dissimilarity Matrix, Proximity Measures for Nominal Attributes and Binary Attributes, Dissimilarity of Numeric Data, Correlation among attributes

Case Study ; Practice on Excel/ R/Weka/Python

UNIT II:

Market Basket Analysis, Frequent Itemsets, Closed Itemsets, and Association Rules Mining Frequent Patterns, Associations, and Correlations Frequent pattern mining: , associative classification, Association rule mining- Apriori Algorithm, Improving the efficiency of Apriori, Various measures support, Confidence, Lift, Evaluation of candidates rules.

Case Study ; Practice on Excel/ R/Weka/Python

UNIT III: **Classification**:

Rule-Based Classification -Decision Tree Induction, Attribute Selection Measures, Tree Pruning, Decision Tree Induction, Bayes Classification Methods, Baye's Theorem, Naive Bayesian Classification, Ensemble Methods, Bagging, Boosting and Ada Boost, Random Forests, Improving Classification Accuracy of Class-Imbalanced Data.

Case Study ; Practice on Excel/ R/Weka/Python

Recommended Books:

1. Keith M Martin, "Everyday Cryptography", Oxford University Press
2. V.K Pachghare,"Cryptography and Network Security", PHI, 2nd Edition

BSC-CS/BSC-IT-DSE012	Mobile Computing	3L:0T:2P	4 Credits

Course Objective: The objective of the "Mobile Computing" course is to introduce students to the concepts, technologies, and challenges related to mobile computing systems. The course aims to provide students with a comprehensive understanding of mobile devices, wireless communication, mobile application development, and the design considerations for mobile computing environments.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamentals of mobile computing, including the architecture and components of mobile devices.
2. Comprehend wireless communication technologies and protocols used in mobile networks.
3. Design and develop mobile applications for various platforms.
4. Evaluate the challenges and security aspects related to mobile computing.
5. Analyze and design mobile computing systems to meet specific requirements.

Course Content:

Unit 1: Introduction to Mobile Computing

Evolution of mobile computing and its significance, Mobile computing architecture and components, Mobile operating systems and application ecosystems.

Unit 2: Wireless Communication and Mobile Networks

Wireless communication technologies (e.g., GSM, CDMA, Wi-Fi, Bluetooth), Mobile network architecture (cellular networks, ad hoc networks), Mobility management and handover in wireless networks.

Unit 3: Mobile Application Development

Mobile app development frameworks and tools, User interface design for mobile applications, Mobile app development for Android and iOS platforms.

Unit 4: Mobile Web and Cloud Services

Mobile web technologies (HTML5, CSS3, JavaScript), Cloud computing for mobile applications, Location-based services and mobile APIs.

Unit 5: Mobile Security and Emerging Trends

Security challenges in mobile computing, Mobile device management and security solutions, Emerging trends in mobile computing (e.g., IoT integration, wearables).

Recommended Books:

1. "Mobile Computing" by Asoke K. Talukder and Roopa R. Yavagal.
2. "Mobile Computing: Principles and Practice" by Ajay D. Kshemkalyani and Mukesh Singhal.

BSC-CS/BSC-IT-DSE013	Fundamental of Data Science	3L:0T:2P	4 Credits

Course Objective: The objective of this course is to introduce students to the fundamentals of data science and its applications in various domains. The course aims to develop students 'knowledge and skills in data manipulation, data analysis, and data visualization techniques.

Course Outcome: By the end of this course, students should be able to:

1. Understand the fundamental concepts and principles of data science.
2. Apply data manipulation techniques using appropriate tools and libraries.
3. Analyse and visualize data to extract insights and make data-driven decisions.
4. Apply statistical methods and machine learning algorithms to analyse data.
5. Communicate data findings effectively through data visualization and storytelling.

Course Content:

Unit 1: Introduction to Data Science

Overview of data science and its significance, Data science process and lifecycle, Ethical considerations in data science

Unit 2: Data Manipulation and Preparation

Data acquisition and data cleaning techniques, Data pre-processing: handling missing data, outliers, and data normalization, Exploratory data analysis and data profiling

Unit 3: Data Analysis and Statistical Methods

Descriptive statistics and summary measures, Hypothesis testing and statistical inference, Regression analysis and correlation

Unit 4: Machine Learning for Data Science

Introduction to machine learning algorithms, Supervised and unsupervised learning techniques, Model evaluation and selection

Unit 5: Data Visualization and Communication

Principles of data visualization and visual perception, Data visualization techniques and tools, Communicating data findings and storytelling

Recommended Books:

1. "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" by Wes McKinney.
2. "Data Science for Business: What You Need to Know about Data Mining and Data- Analytic Thinking" by Foster Provost and Tom Fawcett.