Model Curriculum for Three/Four Year Degree Course (With Multiple Entry/Exit Option)

Based on NEP-2020

Bachelor of Computer Application (BCA)

Odisha State Higher Education Council, Bhubaneswar

Government of Odisha

Contents

(Students may choose vocational courses after 2nd Semester and 4th Semester for Certificate Course or Diploma Course respectively with 4 *credit each opt for exit)*

Program Outcomes

PO1: To understand the function of various hardware, software, and network components.

PO2: To develop the ability to analyze, design, and develop computer-based solutions for different application domains.

PO3: To be professionally competent in order to adapt to the fast-changing IT industry.

PO4: To be able to use Internet effectively and develop web-based and mobile applications for wider access.

PO5: To develop entrepreneurship skills and venture into start-ups for providing end-to-end solutions.

NB:

Students have to do the laboratory assignments mentioned under different subjects/papers. In order to make the subject more interesting and sync with the current trends in the subject, the course instructor will give additional assignments relevant to the subject, and students are also encouraged to do some experiments on their own.

SYLLABUS STRUCTURE FOR BCA (NEP-2020) FROM 2024-25 A.S.

Semester	Course	Paper	Course Name	Credit
I	Core-I(Major)	I	Problem Solving Using C Programming	04
		II	Introduction to Python Programming	04
	Core-II(Minor)	I	Principle of Management	04
	MDC	I	Student has to choose a subject from MDC Basket-1	03
	VAC	I	Environment Studies & Disaster Management	03
	AEC	I	Any Indian Language offered by University	04
II	Core-I(Major)	III	Data Structures	04
		IV	Object Oriented Programming Using C++	04
	Core-III(Minor)	I	Descriptive Statistics	04
	MDC	II	Student has to choose a subject from MDC Basket-2	03
	SEC	I	Student has to choose a subject from SEC Basket-1	03
	AEC	II	English	04
III	Core-I(Major)	V	Database Management Systems	04
		VI	Computer Organization & Architecture	04
		VII	Operating Systems	04
	Core-II(Minor)	II	Business Accounting	04
	MDC	III	Student has to choose a subject from MDC Basket-3	03
	VAC	II	Ethics & Values	03
IV	Core-I(Major)	VIII	Computer Graphics	04
		IX	Web Development Using PHP	04
		X	Computer Networks	04
	Core-III(Minor)	II	Business Economics	04
	CES/FW/Internship		CES/FW/Internship	04
V	Core-I(Major)	XI	Software Engineering	04
		XII	Introduction to Data Science/ Introduction to AI	04
		XIII	Programming in Java	04
	Core-II(Minor)	III	Organizational Behavior	04
	SEC	II	Student has to choose a subject from SEC Basket-2	03
	VAC	III	Understanding Odisha/Yoga for All	04
VI	Core-I(Major)	XIV	Algorithm Design Techniques	04
		XV	Project Work-I	04
	Core-III(Minor)	III	Numerical Techniques	04
	SEC	III	Student has to choose a subject from SEC Basket-3	03
	VAC	IV	Understanding India/Management Concepts & Practices	03

Semester I

Core –I-Paper-I

Problem Solving using C Programming

Course Objectives:

- To learn the C programming language to solve different scientific and business problems
- To learn how to design and write effectively codes using various programming constructs available in the C programming language

Learning Outcomes:

Upon completion of this course, students will be able to:

- Gain knowledge about different data types and operators in C language
- Learn the use of various control structures and array
- Learn the use of pointers, functions, and storage classes
- Write programs using structures, union, and files

Unit I:

Introduction:Introduction to Programming Language, Introduction to C Programming, Keywords & Identifiers, Constants, Variables, Input and Output Operations, Compilation and pre-processing, Data types: Different data types, Data types qualifier, modifiers, Memory representation, size and range, Operators: Operators (Arithmetic, Relational, Logical, Bitwise, Assignment & compound assignment, Increment & Decrement, Conditional), Operator types (unary, binary, ternary). Expressions, Order of expression (Precedence and associativity)

Unit II:

Decision Control structures & Loops: Decision Making and Branching statements (Simple IF, IF…ELSE, Nested IF… ELSE, ELSE … IF ladder), Selection control structure (Switch Statement). Looping statements (FOR, WHILE, DO…WHILE), break, continue and GOTO statements

Array: Concept of Array, Array Declaration, types of arrays (one and multiple dimension), Character Arrays and Strings, limitation of array.

Unit III:

Pointers: Concept of Pointer (NULL pointer, wild pointer, dangling pointer, generic pointer), Pointer Expressions, Accessing the Address of a Variable, Declaring Pointer Variables, Initializations of Pointer Variable, accessing a Variable through its Pointer, Pointer arithmetic, Pointer representation of array, Array of Pointers, Accessing Sting using Pointer.

Function: Types of Function, Function Declaration, Function Definition, Function Call, Recursive Function, Dynamic Memory Management functions, String handling function (strlen, strcmp, strcpy, strncpy, strcat, strstr).

Storage class: Types (auto, register, static, extern), scope rules, declaration and definition.

Unit IV:

Structure and Union: Defining, Declaring, Accessing, Initialization Structure, nested structure, self-referential structure, bit-field, Arrays of Structures, Structures and Functions, structures and pointers, Unions, difference between structure and union, structure within union. File: File Management in C, Defining and Opening a File, File opening modes (read, write, append), Closing a File, File operations, Error handling during I/O Operations, sequential and random access files. Command line arguments.

Text Books:

- ✓ *Programming in ANSI C by E. Balagurusamy, TMH*
- ✓ *Let us C by Yashavant Kanetkar, BPB Pubs.*
- ✓ *C: How to Program by Paul Deitel, Harvey Deitel, Prentice Hall.*

Reference Books:

- ✓ *The C Programming Language by B. Kernighan & Dennis Ritchie, PHI.*

BCA 1.1 Lab: Problem Solving using C Programming

1. Write a Program to find greatest among three numbers.
2. Write a Program to all arithmetic operation using switch case.
3. Write a Program to print the sum and product of digits of an integer.
4. Write a Program to reverse a number.

5. Write a Program to compute the sum of the first n terms of the following series

   S = 1+1/2+1/3+1/4+……
6. Write a Program to compute the sum of the first n terms of the following series

   S =1-2+3-4+5…….
7. Write a function that checks whether a given string is Palindrome or not. Use this function to find whether the string entered by user is Palindrome or not.
8. Write a function to find whether a given number is prime or not. Use the same to generate the prime numbers less than 100.
9. Write a Program to compute the factors of a given number.
10. Write a program to swap two numbers.
11. Write a Program to print a triangle of stars as follows (take number of lines from user):

    *

    ***

    *****

    ****
12. Write a Program to perform following actions on an array entered by the user:
    a) Print the even-valued elements
    b) Print the odd-valued elements
    c) Calculate and print the sum and average of the elements of array
    d) Print the maximum and minimum element of array
    e) Remove the duplicates from the array
    f) Print the array in reverse order

    The program should present a menu to the user and ask for one of the options. The menu should also include options to re-enter array and to quit the program.
13. Write a Program that prints a table indicating the number of occurrences of each alphabet in the text entered as command line arguments.
14. Write a program that swaps two numbers using pointers.

15. Write a program in which a function is passed address of two variables and then alter its contents.
16. Write a program which takes the radius of a circle as input from the user, passes it to another function that computes the area and the circumference of the circle and displays the value of area and circumference from the main( ) function.
17. Write a program to find sum and average of n elements entered by the user. To write this program, allocate memory dynamically using malloc( ) / calloc( ) functions.
18. Write a menu driven program to perform following operations on strings:
    a) Show address of each character in string
    b) Concatenate two strings without using strcat function.
    c) Concatenate two strings using strcat function.
    d) Compare two strings
    e) Calculate length of the string (use pointers)
    f) Convert all lowercase characters to uppercase
    g) Convert all uppercase characters to lowercase
    h) Calculate number of vowels
    i) Reverse the string
19. Given two ordered arrays of integers, write a program to merge the two-arrays to get an ordered array.
20. Write a program to copy the content of one file to other.

Core-I-Paper-II

Introduction to Python Programming

Course Objectives:

1. To gain a solid understanding of basic programming concepts of Python.
2. To understand and write programs using Python.
3. Apply Python programming skills to develop practical, real-world applications and projects.

Learning Outcomes:
Upon completion of this course, Students will be able to learn:

- Basics of Python construct.
- Basics of decision making and looping, use of list, set, tuples and dictionary
- Creation and use of functions
- Object-oriented concepts, handling exceptions, operations on files

Unit I:
Introduction to Python, getting started with Python, Python Basics: Identifiers, Keywords, Python types, basic types, mutable and immutable types, Integer & float ranges, Variable type & assignment, Arithmetic Operators, Precedence & Associativity, Conversions, built-in functions, modules, container types, comments & indention, multi-lining.

Strings: Introduction, Accessing String elements, Properties, built-in functions, Methods, Conversions, Comparisons. Console I/O: I/O operations, formatted printing.

Unit II:
Decision Control Instruction: Logical operators, Conditional Expressions, all () & any (), receiving input, pass statement. Repetition Control Instruction: types, usage of loops, break & continue, else block of a loop.
Lists, Sets, Tuples, Dictionaries: creating, accessing, and looping-in each type. Applying basic operations, using built-in functions and methods on each type, possible data structure / mathematical operations on each type. Comprehensions on List, Set, and dictionary.

Unit III:
Functions: built-in and user-defined functions, invoking functions, unpacking arguments. Recursive function, iteration vs recursion. Lambda functions, map, filter, reduce function.
Modules and Packages: Main module, importing a module, packages, programs using modules and packages.

Unit IV:
Classes & Objects: Programming paradigms, public and private members, declaring classes, creating objects, class variables, methods, operator overloading, containership, features and types of inheritance.
Exception Handling: Introduction, handling exception, user-defined exceptions, else block, finally block. File Input/Output: Opening a file, modes of opening a file, operations: reading, writing. Use of *with* keyword.

Text Book:

- ✓ *Python Programming: Using Problem Solving Approach by Reema Thareja, Oxford University Press*

Reference Books & e-Resources:

- ✓ *Let us Python by Yashavant Kanetkar & Aditya Kanetkar, BPB Pub.*
- ✓ *https://docs.python.org*

BCA 2.1 Lab: Introduction to Python Programming

1. Write a program to demonstrate the usage of various arithmetic operators.
2. Write a program that will convert various temperatures.
    3. a. Fahrenheit to Centigrade
    4. b. Centigrade to Fahrenheit
5. Write a program that will find the roots of a quadratic equation: $ax^2 + bx + c = 0$
6. Write a program that demonstrate the usage of various String functions.
7. Write a program that will ask you to enter your name, through keyboard, and perform following operations
    8. a. Find the middle name
    9. b. Find the last name (using string slicing)
    10. c. Re-write the name with surname first.
11. Write a program to find out whether the integer entered by the user, through the keyboard, is even or odd number.

12. Find out the youngest among Shyam, Dugu and Ishan whose ages are entered by the user through keyboard.
13. Given three points (x1, y1), (x2, y2), (x3, y3), write a program to check all the three points fall on one straight line.
14. Write a program to demonstrate basic operations on the list.
15. Write a program to demonstrate stack and queue operations using a list of numbers.
16. Write a program to ask the data of five students that contain name, roll number, age. Sort the list based on roll number of the Student. [Note: Use list of lists].
17. Write a program to demonstrate basic operations on the tuple.
18. Store the data about the shares held by the user as tuples containing the following information about shares: share name, cost price, number of shares, selling price. Write a program to determine:
    a. total cost of the portfolio
    b. total amount gained or lost
19. Write a program to demonstrate basic operations on the set.
20. Write a program to demonstrate basic operations on the dictionary.
21. Create a dictionary to store data (name, roll number) of N students. The key will be the roll number of the student and the value contains the data of the student (in a list). Write a program that asks the user to enter a name of a Student, search it in the dictionary and print the data of the Student if it is available otherwise display an appropriate message.
22. Write a program to demonstrate basic comprehensions on list, set and dictionary.
23. Write a program to find the factorial value of a number entered by the user using function.
24. Write a program to find the factorial of a number using recursion.
25. Write a program to showcase use of Lambda functions, map, filter, reduce function.
26. Create a Python class called "Student" that encapsulates various attributes of a student. Implement methods within the class to perform operations utilizing these attributes.
27. Write a program to demonstrate both Static and Dynamic Polymorphism in Python.
28. Write a program to demonstrate exception handling mechanisms for various types of exceptions.
29. Write a program to read texts from a file and write them into another file.

Semester II

Core-I-Paper-III

Data Structures

Course Outcomes:

- To understand different ways of organizing data in computer's memory.
- To learn different operations on data structures.
- To explore different applications of data structures.

Learning Outcomes:

Upon completion of this course, students will be able to:

- Learn about data structures and the use of array
- Create linked lists and perform insertion/deletion operations on them
- Represent Stack and Queue in the memory and learn their applications
- Learn the use of various non-linear data structures and their applications

Unit I:

- Introduction to Data Structures: Definition, Concepts, Classification of Data Structures.
- Array: Introduction, One-Dimensional Array, Memory representation, Operations: Traversing, Searching, Insertion, Deletion, Merge. Two-Dimensional Array & Memory Representation, Multidimensional Array. Linear Search versus Binary Search, Sorting: Selection Sort, Bubble Sort.

Unit II:

- Linked Lists: Definition, Single Linked List, Memory representation, Operations: Traversing, Searching, Insertion, Deletion and Merge. Double Linked List, Operations: Insertions, Deletion.
- Circular, Double Circular Linked list, Operations: Traversing, Insertion. Applications of Linked List, Sparse Matrix and Polynomial representations.

Unit III:

- Stack:Definition, Representation: Array and Linked List representations, Operations: PUSH, POP, STATUS. Applications: Evaluation of Arithmetic Expressions: Notations, Infix to Postfix Conversion, Evaluation of Postfix expression. Recursion (Factorial and Fibonacci), Tower of Hanoi.
- Queues:Definition, Representation: Array and Linked List representations, Operations: Enqueue, Dequeue. Structures of Queue: Circular, Deque and Priority Queue. Applications of Queue

Unit IV:

- Trees: Definition, Terminologies, Binary Tree: Properties, Representations (Linear and Linked List representations). Operations: Traversal (Inorder, Preorder, Postorder), Search. Introduction to Binary Search Tree, AVL tree, M-Way Search Tree. Applications of Trees.
- Graph: Definition, Terminologies, Representations (Set, Linked List, Matrix), Operations: Traversal (BFS, DFS). Applications of Graphs.

Text Books:

- ✓ *Classic Data Structure, D. Samanta, PHI, 2/ed.*
- ✓ *Ellis Horowitz, SartajSahni, "Fundamentals of Data Structures", Galgotia Pubs*.

Reference Book:

- ✓ *Sastry C.V., Nayak R, Ch. Rajaramesh, Data Structure & Algorithms, I. K. International ,Publishing House Pvt. Ltd, New Delhi.*

BCA 3.1 Lab: Data Structures

Write C Programs for the followings:

1. To search an element and print the total occurrences in the array.
2. To insert and delete elements into/from appropriate position in an array.
3. To perform Binary Search.
4. To perform Bubble sort.
5. To perform Selection sort.
6. To implement linear linked list and perform operations such as traverse, search, insert, delete, and reversing the list.
7. To implement circular linked list and perform operations such as node insert and delete.
8. To implement double linked list and perform operations such as node insert and delete.
9. To represent a Sparse Matrix using linked list.
10. Polynomial representation using linked list.
11. Array and Linked list implementations of Stack and perform operations such as push, pop and status.
12. Linked list implementation of Queue and perform operations such as enqueue and dequeue.
13. Linked list implementation of Circular Queue.
14. To implement a Binary Search Tree.
15. To perform tree traversal operations.
16. To implement adjacency matrix for a given graph.
17. To perform BFS and DFS traversal.

Core-I-Paper-IV

Object Oriented Programming using C++

Course Outcomes:

- To know about the Object-Oriented Programming concepts.
- To write object-oriented programs using C++ constructs

Learning Outcomes:

Upon completion of this course, students will be able to:

- Understand OOPs concepts as a programming style
- Use class/objects in programs and functions of different types
- Learn the concept of inheritance and overloading of functions and operators
- Use files in C++

Unit I:

Principles of Object-Oriented Programming: Object-Oriented Programming(OOP) Paradigm, Basic Concepts of OOP, Benefits of OOP, Characteristics of OOPS, Object Oriented Languages, Applications of OOP.

Introduction to C++, Difference between C & C++, Tokens, Data types, Operators, structure of C ++ Program, C++ statements, Expressions and Control Structures.

FunctionsinC++: Argument passing in function, Inline Functions, Default Arguments, Const. Arguments, Friend function.

Unit II:

Classes and Objects: Defining Member Functions, Making an outside Function Inline, Nested Member Functions, Private Member Functions, Arrays with in a Class, Memory Allocation for Objects, Static Data Members, Static Member Functions, Arrays of Objects, Objects as Function Arguments, Friend Functions.

Constructors& Destructors: Constructors, Parameterized Constructors, Constructors with Default Arguments, Dynamic Initialization of Objects, Copy Constructor, Dynamic Constructors, Destructors.

Unit III:

Inheritance: Basics of Inheritance, Type of Inheritance, Virtual Base Classes, Abstract Classes, Member Classes, Nesting of Classes. Polymorphism: Pointers, Pointers to Objects, this Pointer, Pointers to Derived Classes, Virtual Functions, Pure Virtual Functions, Function Overloading, Operator Overloading.

Unit IV:

Managing Console I/O Operations: C++ Streams, C++ Stream Classes, Unformatted I/O Operations, Formatted Console I/O Operations, Managing Output with Manipulators.

Files: Classes for File Stream Operations, Opening and Closing a File, Detecting end-of-file, File Modes, File Pointers and their Manipulations, Sequential Input and Output Operations, Updating a File: Random Access, Error Handling during File Operations, Command-line Arguments.

TextBooks:

- ✓ *E. Balgurusawmy ,Object Oriented Programming with C++, 4/e(TMH).*

- ✓ *Paul Deitel, Harvey Deitel, "C++: How to Program", 9/e PrenticeHall.*

ReferenceBooks:

- ✓ *Bjarne Stroustroup, Programming-Principles and Practiceusing C++, 2/e,Addison-Wesley Herbtz Schildt, C++: The Complete reference, McGraw Hill.*

Lab: Object Oriented Programming using C++

1. Write a Program for Swapping of two numbers.
2. Write a Program to find sum of four numbers using default argument passing.
3. Write a Program to find square and cube of a number using inline function.
4. Write a Program to find the factorial of a number.
5. Write a Program to find reverse of a number.
6. Write a program to find sum of four numbers using default argument passing in member function.
7. Write a Program to find area of circle, triangle and rectangle using function overloading.
8. Write a program to distinguish the properties of static and non-static at a members.
9. Write a program to show the method of accessing static private member function.
10. Write a program to show the ways of calling constructors and destructors.
11. Write a program to perform ++ operator overloading using member function.
12. Write a program to perform ++ operator overloading using friend function.
13. Write a program to perform + operator overloading for two complex number addition.
14. Write a program to perform + operator overloading for string concatenation.
15. Write a program to perform single inheritance.
16. Write a program to perform multiple inheritance.
17. Write a program to create an integer array using new operator and find the sum and average of array elements.
18. Write a program to implement virtual destructor.
19. Create the Person class. Create some objects of this class (by taking information from the user). Inherit the class Person to create two classes Teacher and Student class. Maintain the respective information in the classes and create, display and delete objects of these two classes (Use Runtime Polymorphism).
20. Write a program to Copy the contents of one file to other.

Semester III

Core-I-Paper-V

Database Management Systems

Course Objectives:

- To understand the database concepts for efficient storage and retrieval of data.
- To learn about database design and transaction processing

Learning Outcomes:

Upon completion of this course, students will be able to:

- Build data models using entity relationship concepts
- Design databases by systematically applying the normalization process
- Create relational database tables and perform various operations using SQL
- Learn issues relating to database transactions and approaches to deal with them

Unit I:

Introduction to Database and Database Users, Database System Concepts and Architecture: data Models, schema, and instances, Conceptual Modeling and Database Design, Entity Relationship (ER) Model: Entity Types, Entity Sets, Attributes, Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, ER Naming Conventions. Enhanced Entity-Relationship (EER) Model.

Unit II:

Relational data Model and SQL: Relational Model Concepts, Basic SQLs, SQL Data Definition and Data types, Constraints in SQL, Retrieval Queries in SQL, INSERT, DELETE, UPDATE Statements in SQL, Relational Algebra and Relational Calculus: Unary Relational Operations: SELECT and PROJECT, Binary Relation: JOIN and DIVISION.

Unit III:

Database Design Theory and Normalization: Functional Dependencies, Normal Forms based on Primary Keys, Second and third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.

Unit IV:

Transaction Processing Concepts: Transaction and System Concepts, Properties of Transactions, Recoverability, Serializability, Concurrency Control Techniques, Locking techniques for Concurrency Control, Concurrency Control based on Time-Stamp Ordering.

Text Books:

- ✓ *Fundamentals of Database Systems, 6th edition, Ramez Elmasri, Shamkant B. Navathe, Pearson Education*
- ✓ *Database Systems Concepts, A. Silberschatz, Henry Korth, S. Sudarshan, TMH.*

Reference Book:

- ✓ *An Introduction to Database System, Date C. J. - Pearson Education, New Delhi*
- ✓ *Database Management Systems, Rajiv Chopra, S. Chand Pubs.*

BCA 3.3 Lab: Data Base Management System

Create and use the following database schema to answer the given queries.

EMPLOYEE Schema

Field	Type	NULL	KEY	DEFAULT
Eno	Char(3)	NO	PRI	NIL
Ename	Varchar(50)	NO		NIL
Job_type	Varchar(50)	NO		NIL
Manager	Char(3)	Yes	FK	NIL
Hire_date	Date	NO		NIL
Dno	Integer	YES	FK	NIL
Commission	Decimal(10,2)	YES		NIL
Salary	Decimal(7,2)	NO		NIL

DEPARTMENT Schema

Field	Type	NULL	KEY	DEFAULT
Dno	Integer	No	PRI	NULL
Dname	Varchar(50)	Yes		NULL
Location	Varchar(50)	Yes		New Delhi

List of Queries:

1. Display Employee Name, Job, Hire Date, Employee Number; for each employee with the Employee Number appearing first.
2. Display unique Jobs from the Employee Table.
3. Display the Employee Name concatenated by a Job separated by a comma.
4. Display all the data from the Employee Table. Separate each Column by a comma and name the said column as THE_OUTPUT.
5. Display the Employee Name and Salary of all the employees earning more than $2850.
6. Display Employee Name and Department Number for the Employee No= 7900.
7. Display Employee Name and Salary for all employees whose salary is not in the range of $1500 and $2850.
8. Display Employee Name and Department No. of all the employees in Dept 10 and Dept 30 in the alphabetical order by name.
9. Display Name and Hire Date of every Employee who was hired in 1981.
10. Display Name and Job of all employees who don't have a current Manager.
11. Display the Name, Salary and Commission for all the employees who earn commission.
12. Sort the data in descending order of Salary and Commission.
13. Display Name of all the employees where the third letter of their name is 'A'.
14. Display Name of all employees either have two 'R's or have two 'A's in their name and are either in Dept No = 30 or their Mangers Employee No = 7788.
15. Display Name, Salary and Commission for all employees whose Commission Amount is 14 greater than their Salary increased by 5%.
16. Display the Current Date.
17. Display Name, Hire Date and Salary Review Date which is the 1st Monday after six months of employment.

18. Display Name and calculate the number of months between today and the date each employee was hired.
19. Display the following for each employee <E-Name> earns < Salary> monthly but wants <3*Current Salary>. Label the Column as Dream Salary.
20. Display Name with the 1st letter capitalized and all other letter lower case and length of their name of all the employees whose name starts with 'J', 'A' and 'M'.
21. Display Name, Hire Date and Day of the week on which the employee started.
22. Display Name, Department Name and Department No for all the employees.
23. Display Unique Listing of all Jobs that are in Department # 30.
24. Display Name, Department Name of all employees who have an 'A' in their name.
25. Display Name, Job, Department No. and Department Name for all the employees working at the Dallas location.
26. Display Name and Employee no. Along with their Manger's Name and the Manager's employee no; along with the Employees Name who do not have a Manager.
27. Display Name, Department No. And Salary of any employee whose department no. and salary matches both the department no. And the salary of any employee who earns a commission.
28. Display Name and Salaries represented by asterisks, where each asterisk (*) signifies $100.
29. Display the Highest, Lowest, Sum and Average Salaries of all the employees.
30. Display the number of employees performing the same Job type functions.
31. Display the no. of managers without listing their names.
32. Display the Department Name, Location Name, No. of Employees and the average salary for all employees in that department.
33. Display Name and Hire Date for all employees in the same dept. as Blake.
34. Display the Employee No. And Name for all employees who earn more than the average salary.
35. Display Employee Number and Name for all employees who work in a department with any employee whose name contains a 'T'.
36. Display the names and salaries of all employees who report to King.
37. Display the department no, name and job for all employees in the Sales department.

Core-I-Paper-VI

Computer Organization & Architecture

Course Objectives:

- To understand the basic components of a digital computer and their working
- To understand data representation techniques and used of various logic gates
- To gain knowledge about processor and various memory devices

Learning Outcomes:

Upon completion of this course, students will be able to:

- Learn basic computer organization and design
- Design various combinational circuits
- Understand the functioning of central processing unit and memory organization
- Understand the use of various input/output organization and parallel processing

Unit I:

Introduction to Computer Organization and Architecture: Basic concepts, Computer evolution and performance, Basic Structure of Computers: Functional Units, Operational Concepts, Bus Structures. Machine Instructions and Programs, Instruction formats, Addressing modes. Overview of Instruction set architecture.
Number systems and their Conversions, Data representation, Arithmetic Operations: Integer-Arithmetic, Floating-point arithmetic.

Unit II:
Boolean Algebra, Basic Logic Functions, Electronic Logic Gates, Synthesis of Logic Functions, Minimization of Logic Expressions, Minimization using Karnaugh Maps.
Combinational circuits: Adders, Subtractors, Multiplexers and Demultiplexers, Sequential circuits: Characteristics, Flip-Flops (SR, JK, D, T)

Unit III:
Memory Organization: Instruction execution cycle, Memory hierarchy: RAM, ROM, Cache memory, Addressing modes and memory addressing techniques.
Processor Organization: CPU organization, Arithmetic logic unit (ALU), Control unit, Instruction pipeline, RISC vs. CISC Architectures.

Unit IV:
Input/Output Organization: I/O interface and devices, Interrupts and DMA (Direct Memory Access). Storage: Disk storage systems, RAID (Redundant Array of Independent Disks).
Parallel Processing: Multiple Processor Organization, Symmetric Multiprocessors, Cache Coherence and MESI Protocol, Multithreading and Chip Multiprocessors, Non-Uniform Memory Access (NUMA). Multicore Computers.

Text Books:
- ✓ *M. Morris Mano, Michael D. Ciletti (2008), Digital Design, 4th edition, Pearson Education Inc, India.*
- ✓ *Carl Hamacher, Zvonks Vranesic, Safea Zaky (2005), Computer Organization, 5th edition, McGraw Hill, New Delhi, India*

Reference Books:
- ✓ *Stallings, W. Computer Organization and Architecture 11th Edition (PHI)*
- ✓ *Computer Architecture and Organization: John P. Hayes McGraw Hill.*
- ✓ *Computer Organization and Design Hardware/ Software Interface: David A. Patterson, John L. Hennessy, Elsevier.*
- ✓ *Computer Architecture & Organization, Rajiv Chopra, S. Chand Pubs.*

Core-I-Paper-VII

Operating Systems

Course Objectives:
- To understand Operating system structure and services.
- To understand the concepts of Process, memory, storage, and I/O management.
- To explore different applications of data structures.

Learning Outcomes:
Upon completion of this course, students will be able to:

- Understand various services offered by an OS as a resource manager
- Understand the concept of a process and various CPU scheduling techniques
- Learn the concepts on effective memory management and virtual memory
- Learn various approaches to disk scheduling & file management techniques

Unit I:

Introduction to Operating System, Computer System Architecture, System Structures: Operating system services, User and Operating-System Interface, system calls, system programs, Operating system design and implementation, Operating system structure, Batch processing, multi-programming, time-sharing and real-time systems

Unit II:

Process Management: Process Concept, Operations on processes, Process scheduling, Inter-process Communication, Threads, Multithreading Models. CPU Scheduling algorithms: Scheduling Criteria, FCFS, SJF, Priority, Round Robin, Multilevel Queue, Multilevel Feedback Queue. Deadlocks: Deadlock detection, deadlock prevention, and deadlock avoidance fundamentals.

Unit III:

Memory Management Strategies: Swapping, Contiguous Memory Allocation, Segmentation, Paging, Virtual Memory Management: Concepts, Demand Paging, Page Replacement techniques: FIFO, LRU, Optimal, Thrashing.

Unit IV:

Storage Management: Overview of Mass-Storage Structure, Disk Scheduling: FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK, RAID technology.
File System concept, Access Methods, Directory and Disk Structure, File System systems, File, Sharing and File Protection.

Text Books:

- ✓ *Operating System Concepts, Abraham Silberschatz, Peter B. Galvin, and Greg Gagne, Eighth Edition, Wiley Student Edition 2009*

Reference Books:

- ✓ *Operating Systems, Rajiv Chopra, S. Chand Pubs.*
- ✓ *Modern Operating System, Tanenbaum, Pearson, 4/ed. 2014*
- ✓ *Operating Systems 5th Edition, William Stallings, Pearson Education India*
- ✓ *Richard Blum, Linux Command Line and Shell Scripting Bible, O' Reilly*

BCA 4.2 Lab: Operating Systems

1. Basic Linux Commands and Overview (date, cal, who, tty, echo, bc, pwd, mkdir, rmdir, cd, cat, cp, mv, rm, ls, wc)

2. Write a shell script to perform the tasks of basic calculator.
3. Write a shell script to find the greatest number among the three numbers.
4. Write a shell script to check if the number entered at the command line is prime or not.
5. Write a shell script to display the multiplication table of any number.
6. Write a shell script to compare two files and if found equal asks the user to delete the duplicate file.
7. Write a shell script to find the sum of digits of a given number.
8. Write a shell script to find the factorial of a given number.
9. Write a program (using fork() and/or exec() commands) where parent and child execute:
    a. same program, same code.
    b. same program, different code.
    c. before terminating, the parent waits for the child to finish its task.
10. Write a program to copy files using system calls.
11. Write a program using C to implement FCFS scheduling algorithm.
12. Write a program using C to implement Round Robin scheduling algorithm.
13. Write a program using C to implement SJF scheduling algorithm.
14. Write a program using C to implement first-fit, best-fit, and worst-fit allocation strategies.

Semester IV

Core-I-Paper-VIII

Computer Graphics

Course Objectives:

- To understand basic concepts of computer graphics.
- To learn techniques for creating basic graphical structures
- To learndifferent transformation techniques

Learning Outcomes:

Upon completion of this course, students will be able to:

- Know the use of different graphics systems
- Learn different algorithms to draw geometrical figures
- Learn various geometric transformation techniques
- Learn techniques for clipping

Unit I:

Computer Graphics: A Survey of Computer graphics, Overview of Graphics System: Video Display Devices, Raster-Scan Systems, Input Devices, Hard-Copy Devices, Graphics Software.

Unit II:

Graphics Output Primitives: Point and Lines, Algorithms for line, circle & ellipse generation, Filled-Area Primitives. Attributes of Graphics Primitives: Point, line, curve attributes, fill area attributes, Fill methods for areas with irregular boundaries.

Unit III:

Geometric Transformations (both 2-D & 3-D): Basic Geometric Transformations, Transformation Matrix, Types of transformation in 2-D and 3-D Graphics: Scaling, Reflection, shear transformation, rotation, translation. 2-D, 3-D transformation using homogeneous coordinates.

Unit IV:

Two-Dimensional Viewing: Introduction to viewing and clipping, viewing transformation in 2-D, viewing pipeline, Clipping Window, Clipping Algorithms: Point clipping, Line clipping and Polygon clipping.

Text Books:

- ✓ *Donald Hearn & M. Pauline Baker, "Computer Graphics with OpenGL", Pearson Education.*
- ✓ *Mathematical Elements for Computer Graphics, D. F. Rogers & J. A. Adams, MGH, 2/ed.*

Reference Books:

- ✓ *Computer Graphics principles & practice, Foley, Van Dam, Feiner, Hughes Pearson Education*

✓ *Computer Graphics by Zhigang Xiang, Roy A Plastic, McGraw-Hill*

BCA 4.3 Lab: Computer Graphics using OpenGL

1. Write a program to implement Bresenham's line drawing algorithm.
2. Write a program to implement mid-point circle drawing algorithm.
3. Write a program to clip a line using Cohen and Sutherland line clipping algorithm.
4. Write a program to clip a polygon using Sutherland Hodgeman algorithm.
5. Write a program to fill a polygon using Scan line fill algorithm.
6. Write a program to apply various 2D translation transformation.
7. Write a program to apply 2D object homogenous coordinates translation.
8. Write a program to apply various 2D rotation transformation.
9. Write a program to apply 2D object homogenous coordinates rotation.
10. Write a program to apply various 2D scaling transformation.
11. Write a program to apply 2D object homogenous coordinates scaling transformation.
12. Write a program to apply various 3D transformations on a 3D object and then apply parallel and perspective projection on it.

Core-I-Paper-IX

Web Development with PHP

Course Objectives:

- To understand the essentials of Server-side programming
- To understand web development using PHP

Learning Outcomes:

On successful completion of this course, Students will be able to:

- Learn the basics of JSON, XML and AJAX
- Learn the programming concepts of PHP
- Learn the server-side programming using PHP
- Learn the mechanisms of connecting Database using PHP & use AJAX with PHP

Unit I:

Introduction to Server Side Technologies, Web Servers, Understanding the concepts of JSON, AJAX: Introduction, Creating Internet Applications using AJAX. XML: Introduction, Features, Fundamentals, Document Type Definition, XML Schema.

Unit II:

PHP: Features, Programming fundamentals: Print/echo statement, Data Types, Variables, Constants, Strings, Arrays, Operators. Control Structures: Conditional, Looping & Jump Statements. Functions: String, Date-Time, Mathematical and User-defined functions. Embedding PHP in HTML, Reading Form data of a Web Page.

Unit III:

Introduction to PHP with Database: Connecting to Database, Selecting a Database, Adding Table and Altering a Table in a Database. Inserting Data, Modifying Data in a Table, Retrieving Data from a table and displaying in HTML.

Unit IV:

State Management in PHP: Introduction, Cookies, Session. Authentication in PHP: Creating a User, Adding authorized users, Displaying the User. Using AJAX: AJAX with PHP, AJAX with Database.

Text Book:

- ✓ *Web Technologies (Black Book), Dream Tech Press*
- ✓ *Matt Doyle, Beginning PHP 5.3 (wrox-Willey publishing)*
- ✓ *John Duckett, Beginning HTML, XHTML, CSS and Java script*

Reference Books:

- ✓ *Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP 4th Edition by Ivan Bayross.*
- ✓ *PHP and MySQL Web Development by Luke Welling and Laura Thomson*. Addison - Wesley.

BCA 5.1 Lab: Web Development with PHP

1. Write PHP program (s) for the following.
    a. Find greatest among three numbers entered by the user
    b. Print the sum of numbers from M to N where their values are entered by the user.
    c. Find the factorial of a number entered by the user.
2. Write a PHP program that asks the name and date of birth of the user.
    a. Find the number of letters, words in the name
    b. Display the Name in reverse order
    c. Print the current date and time and age of the user.
3. Design a web page to create a form that collects the name, gender and mail of a person. Write a PHP program that collects the data entered by the user in the form and displays them in a new page.
4. Write a PHP program that creates a Table in a database. The number of columns of the table are determined by the fields in the form (created in question no. 3).
5. Write a PHP program to
    a. insert new records
    b. update a record
    c. delete a record based on a value of a field in the table.

6. Write a PHP program that asks the user to enter a name and display the details of the user retrieved from the database in the same page. [show the error message if no matching name is found in the database].
7. Write a PHP program to create a cookie and store your name and then read the cookie.
8. Write a PHP program that allows only authenticated users to retrieve the details of a table. [Use username and password of the user to validate the authenticity].
9. Write a PHP application to make use of AJAX.

Core-I-Paper-X

Computer Networks

Course Outcomes:

- To understand data communication and network concepts.
- To learn about different communication standards
- To understand different network protocols

Learning Outcomes:

Upon completion of this course, students will be able to:

- Understand concepts on data communication and the use of communication devices
- Learn about analog and digital signals and basic components of data communication
- Learn about errors during data communication & access control mechanisms
- Learn various network protocols and network security issues

Unit I:

Introduction to Data Communications and Network Models: Protocols and Standards, Layers in OSI Models, Analog and Digital Signals, Network Topology, Transmission Modes, Transmission Impairment, Data Rate Limits, Performance, Digital Transmission, Network Devices & Drivers: Router, Modem, Repeater, Hub, Switch, Bridge (fundamental concepts only).

Unit II:

Signal Conversion: Digital-to-Digital Conversion, Analog-to-Digital Conversion, Digital-to-analog Conversion, Analog-to-analog Conversion. Switching Techniques: Packet Switching, Circuit Switching, Datagram Networks, Virtual-Circuit Networks, and Structure of a Switch.

Unit III:

Error Detection and Correction: Parity Check, Checksum, CRC, Error correction technique (Hamming code), Data Link Control: Framing, Flow and Error Control, Noiseless Channels, Noisy channels, (Stop and Wait ARQ, Sliding Window Protocol, Go Back N, Selective

Repeat) Point-to-Point Protocol. Access Control: TDM, CSMA/CD, and Channelization (FDMA, TDMA, and CDMA).

Unit IV:

Network Layer: Logical Addressing, IPv4 Addresses, IPv6 Addresses, Subnet, Subnetmasking, Virtual-Circuit Networks: Frame Relay and ATM, Transport Layer: Process-Process Delivery: UDP, TCP. Application layers: DNS, SMTP, POP, FTP, HTTP, Basics of WiFi (Fundamental concepts only), and Network Security: Authentication, Basics of Public Key and Private Key Cryptography, Digital Signatures and Certificates (Fundamental concepts only).

Text Book:

- ✓ *Data Communications and Networking, Fourth Edition by Behrouza A. Forouzan, TMH.*

Reference Book:

- ✓ *Computer Networks, A. S. Tanenbaum, 4th edition, Pearson Education.*

Semester V

Core-I-Paper-XI

Software Engineering

Course Outcomes:

- To understand importance of Software engineering.
- To understand different software development models
- To understand various issues involved in a software development project

Learning Outcomes:

Upon completion of this course, students will be able to:

- Understand various software development lifecycle models
- Know the complexities involved in software development projects & how to deal with them
- Understand the software design process starting from requirement analysis
- Learn about software documentation, software testing and maintenance

Unit I:

Introduction: Evolution of Software to an Engineering Discipline, Software Development Projects, Exploratory Style of Software Development, Emergence of Software Engineering, Changes in Software Development Practices, Computer Systems Engineering. Software Lifecycle Models: Waterfall Model and its Extensions, Rapid Application Development (RAD), Agile Development Models, Spiral Model.

Unit II:

Software Project Management: Software Project Management Complexities, Responsibilities of a Software Project Manager, Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques, Empirical Estimation Techniques, COCOMO, Halstead's Software Science, Staffing Level Estimation, Scheduling, Organization and Team Structures, Staffing, Risk Management, Software Configuration Management.

Unit III:

Requirement Analysis and Specification: Requirements Gathering and Analysis, Software Requirement Specifications, Formal System Specification Axiomatic Specification, Algebraic Specification, Executable Specification and 4GL.
Software Design: Design Process, Characterize a Good Software Design, Cohesion and Coupling, Layered Arrangements of Modules, Approaches to Software Design (Function Oriented & Object-Oriented).

Unit IV:

Coding and Testing: Coding: Code Review, Software Documentation, Testing, Unit Testing, Black Box and White Box Testing, Debugging, Program Analysis Tools, Integration Testing, System Testing, Software Maintenance.

Text Books:

- ✓ *Software Engineering– Ian Sommerville, 10/Ed, Pearson*
- ✓ *Fundamental of Software Engineering, Rajib Mall, Fifth Edition, PHI Publication, India.*

Reference Books:

- ✓ *Software Engineering Concepts and Practice – Ugrasen Suman, Cengage Learning India Pvt. Ltd.*
- ✓ *Software Engineering, R Khurana, Vikash Pubs*.

Core-I-Paper-XII

(A) Introduction to Artificial Intelligence

(Students can choose any one course from this group)

Course Outcomes:

- To learn the basic concepts of AI.
- To understand AI problem-solving approaches

Learning Outcomes:

Upon completion of this course, students will be able to:

- Understand state space search as an approach to AI problem solving
- Understand various Knowledge Representation techniques
- Learn the complexity involved in NLP & role of learning in AI problem-solving
- Understand the importance of Expert systems and the use of AI programming languages.

Unit I:

Introduction to AI, Scope of AI, Characteristics of AI problems, Turing test, Concept of Intelligent agents, Approaches to AI problem-solving, State space search, production system, Uninformed search: Breadth-First, Depth-First, Iterative deepening, bidirectional and beam search.

Unit II:

Informed/Heuristic search: Generate-and-Test, Hill climbing, Best-first search, A^* algorithm, Problem reduction, AO^*, Constraint satisfaction, Solution of CSP using search, Means-End analysis.

Unit III:

Knowledge Representation: Propositional logic and Predicate logic along with their resolution principles, Unification algorithm, forward and backward chaining and conflict resolution, Semantic nets, Frames, Conceptual dependencies, Scripts.
Reasoning under uncertainty: Bayesian Belief networks, Dempster Shafer theory

Unit IV:

Natural language processing: Introduction, Levels of knowledge in language understanding, , Phases of Natural language understanding, top-down and bottom-up parsing, transition networks.
Expert Systems: Introduction, Architecture, Expert system development cycle, Examples of ES: Mycin and Dendral.

Text Books:

- ✓ *Artificial Intelligence by Rajiv Chopra, S. Chand Pubs.*
- ✓ *Artificial Intelligence by E. A. Rich and Kelvin Knight, TMH*

Reference Books:

- ✓ *Introduction to AI and Expert Systems- D.W. Patterson, PHI*
- ✓ *Principles of AI and Expert systems development, D. W. Rolston (McGraw Hill)*

(B) Introduction to Data Science

Course Objectives:

- To understand emergingissuesrelated tovariousfieldsofdatascience.
- To understand theunderlyingprinciples ofdatascience,exploringdataanalysis.
- To learnthe basicsofRProgramming.

Learning Outcomes:
Upon completion of this course, students will be able to:

- Appreciate the importance of data science & learn the use different data analysis tools
- Learn RProgramming
- Understand the techniques for data cleaning
- Learn the use of various data analysis and visualization tools

Unit I:
Data Scientist's Tool Box: Turning data into actionable knowledge, introduction to the tools that are used in building data analysis software: version control, mark down, git, GitHub, R, and R Studio.

Unit II:

R Programming Basics: Overview of R, R data types and objects, reading and writing data, Control structures, functions, scoperules, datesandtimes, Loop functions, debugging tools, Simulation, code profiling.

Unit III:

Getting and Cleaning Data: Obtaining data from the web, from APIs, from databases and other sources in various formats, basics of data cleaning and making data "tidy".

Unit IV:

Exploratory Data Analysis: Essential exploratory techniques for summarizing data, applied

before formal modelling commences, eliminating or sharpening potential hypothesesabout the world that can be addressed by the data, common multivariate statistical techniques used to visualize high-dimensional data.

TextBook:

- ✓ *Rachel Schutt, Cathy O'Neil," Doing Data Science: Straight Talk from the Front line" Schroff / O'Reilly, 2013.*

ReferenceBooks:

- ✓ *Foster Provost, Tom Fawcett, "Data Science for Business" What You Need to Know About Data Mining and Data-Analytic Thinking by O'Reilly, 2013.*
- ✓ *John W. Foreman, "Data Smart: Using data Science to Transform Information into Insight" by John Wiley & Sons, 2013.*
- ✓ *Eric Seigel, "Predictive Analytics: The Power to Predict who Will Click, Buy, Lie, or Die", 1st Edition, by Wiley, 2013.*

BCA 5.4B Lab: Introduction to Data Science

1. Study of basic Syntaxes in R
2. Implementation of vector data objects operations
3. Implementation of matrix, array and factors and perform variance analog in R
4. Implementation and use of data frames in R
5. Create Sample (Dummy) Data in R and perform data manipulation with R
6. Study and implementation of various control structures in R
7. Data Manipulation with dplyr package
8. Data Manipulation with data table package
9. Study and implementation of Data Visualization with ggplot2
10. Study and implementation data transpose operations in R

Core-I-Paper-XIII

Programming in Java

Course Outcomes:

- To learn Java for writing object-oriented programs
- To understand theuse of different Java programming constructs
- To learnexception handling in Java and use of threads.

Learning Outcomes:
Upon completion of this course, students will be able to:

- Learn the basics of Java programming
- Create classes/objects and implement different forms of inheritance
- Use arrays and files in Java
- Learn about exception handling

Unit I:

Introduction to Java: Java History, Architecture and Features, Understanding the semantic and syntax differences between C++ and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords (super, this, final, abstract, static, extends, implements, interface) , Data Types, Wrapper class, Operators (Arithmetic, Logical and Bitwise) and Expressions, Comments, Doing Basic Program Output, Decision Making Constructs (conditional statements and loops) and Nesting, Java Methods (Defining, Scope, Passing and Returning Arguments, Type Conversion and Type and Checking, Built-in Java Class Methods). Input through keyboard using Command line Argument, the Scanner class, BufferedReader class.

Unit II:

Object-Oriented Programming Overview: Principles of Object-Oriented Programming, Defining & Using Classes, Class Variables & Methods, Objects, Object reference, Objects as parameters, final classes, Garbage Collection. Constructor- types of constructors, this keyword, super keyword. Method overloading and Constructor overloading. Aggregation vs Inheritance, Inheritance: extends vs implements, types of Inheritance, Interface, Up-Casting, Down-Casting, Auto-Boxing, Enumerations, Polymorphism, Method Overriding and restrictions. Package: Pre-defined packages and Custom packages.

Unit III:

Arrays: Creating & Using Arrays (1D, 2D, 3D and Jagged Array), Array of Object, Referencing Arrays Dynamically. Strings and I/O: Java Strings: The Java String class, Creating & Using String Objects, Manipulating Strings, String Immutability& Equality, Passing Strings To & From Methods, StringBuffer Classes and StringBuilder Classes. IO package: Understanding StreamsFile class and its methods, Creating, Reading, Writing using classes: Byte and Character streams, FileOutputStream, FileInputStream, FileWriter, FileReader, InputStreamReader, PrintStream, PrintWriter. Compressing and Uncompressing File.

Unit IV:

Exception Handling, Threading, Networking and Database Connectivity: Exception types, uncaught exceptions, throw, built-in exceptions, Creating your own exceptions; Multi-threading: The Thread class and Runnable interface, creating single and multiple threads, Thread prioritization, synchronization and communication, suspending/resuming threads.

Using java.net package, Overview of TCP/IP and Datagram programming. Accessing and manipulating databases using JDBC.

Text Book:

- ✓ *E. Balagurusamy, "Programming with Java", TMH, 4/Ed*

Reference Book:

- ✓ *Herbert Schildt, "The Complete Reference to Java", TMH, 10/Ed.*

BCA 6.1 Lab: Programming in Java

1. To find the sum of any number of integers entered as command line arguments.
2. To find the factorial of a given number.
3. To convert a decimal to binary number.
4. To check if a number is prime or not, by taking the number as input from the keyboard.
5. To find the sum of any number of integers interactively, i.e., entering every number from the keyboard, whereas the total number of integers is given as a command line argument.
6. Write a program that show working of different functions of String and StringBufferclasss like setCharAt( ), setLength( ), append( ), insert( ), concat( )and equals( ).
7. Write a program to create a – "distance" class with methods where distance is computed in terms of feet and inches, how to create objects of a class and to see the use of this pointer
8. Modify the – "distance" class by creating constructor for assigning values (feetandinches) to the distance object. Create another object and assign second object as reference variable to another object reference variable. Further create a third object which is a clone of the first object.
9. Write a program to show that during function overloading, if no matching argument is found, then Java will apply automatic type conversions (from lower to higher data type).
10. Write a program to show the difference between public and private access specifiers. The program should also show that primitive data types are passed by value and objects are passed by reference and to learn use of final keyword.
11. Write a program to show the use of static functions and to pass variable length arguments in a function.
12. Write a program to demonstrate the concept of boxing and unboxing.
13. Create a multi-file program where in one file a string message is taken as input from the user and the function to display the message on the screen is given in another file (make use of Scanner package in this program).
14. Write a program to create a multilevel package and also creates a reusable class to generate Fibonacci series, where the function to generate Fibonacci series is given in a different file belonging to the same package.
15. Write a program that creates illustrates different levels of protection in classes/subclasses belonging to same package or different packages
16. Write a program – "DivideByZero" that takes two numbers a and b as input, computes a/b, and invokes Arithmetic Exception to generate a message when the denominator is zero.

17. Write a program to show the use of nested try statements that emphasizes the sequence of checking for catch handler statements.
18. Write a program to create your own exception types to handle situation specific to your application (Hint: Define a subclass of Exception which itself is a subclass of Throwable).
19. Write a program to demonstrate priorities among multiple threads.
20. Write a program to demonstrate different mouse handling events like mouseClicked(), mouseEntered(), mouseExited(), mousePressed(), mouseReleased() &mouseDragged().
21. Write a program to demonstrate different keyboard handling events.

Semester VI

Core-I-Paper-XIV

Algorithm Design Techniques

Course Objectives:

- To understand the importance of algorithm design.
- To learn ways to analyze algorithms
- To learnabout adoption of different algorithmic styles for solving problems

Learning Outcomes:

Upon completion of this course, students will be able to:

- ✓ Learn approaches to algorithm analysis & design
- ✓ Learn different searching and sorting techniques
- ✓ Learn greedy techniques for problem-solving
- ✓ Learn graph-based techniques for practical problem-solving

Unit I:

Algorithm specification: Pseudo code, Asymptomatic Analysis, Space complexity and time complexity, Analysis and design of Insertion sort algorithm, Divide and Conquer paradigm, Recurrence relations, Solving Recurrences: Substitution methods, Recursion tree method, and Master method.

Unit II:

Searching and Sorting:Analysis of Linear Search, Binary Search, Merge Sort and Quick Sort, Heap Sort. Hashing: Hash functions, Hash table, Collision resolution: Chaining and Open Addressing (Linear probing, Quadratic probing, Double hashing).

Unit III:

Greedy Technique:General Method, Applications: Fractional Knapsack Problem, Job Sequencing with Deadlines, Huffman Codes.
Dynamic Programming:General Method, Applications: Matrix Chain Multiplication, longest common subsequence, 0/1 Knapsack.

Unit IV:

Graph Algorithms, Topological sort, Minimum Spanning Trees: Prim's and Kruskal's algorithm, Single-source shortest paths: Bellman-Ford algorithm, Dijkstra's algorithm.

Text Book:

- ✓ *Introduction to Algorithms, by Thomas H, Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, PHI.*

Reference Book:

- ✓ *Algorithm Design, by Jon Kleinberg, Eva Tardos*.

BCA 6.2 Lab: Algorithm Design Techniques

1. Write C / C++ Programs to implement Insertion Sort
2. Write C / C++ Programs to implement Merge Sort
3. Write C / C++ Programs to implement Quick Sort
4. Write C / C++ Programs to implement Heap Sort
5. Write C / C++ Programs to implement Hashing
6. Write C / C++ Programs to implement Fractional Knapsack
7. Write C / C++ Programs to implement Matrix Chain Multiplication
8. Write C / C++ Programs to implement Longest Common Subsequence
9. Write C / C++ Programs to implement Huffman Code
10. Write C / C++ Programs to implement Prim's Algorithm
11. Write C / C++ Programs to implement Krushkal's Algorithm
12. Write C / C++ Programs to implement Dijkstra's Algorithm

Core-I-Paper-XV

BCA 6.3: Project Work-I

A student has to do a Project work under the guidance of a faculty member. After completing the project, the student has to submit a project report which has to be evaluated by an external examiner. The model template for the project report can be as follows

1. Title of the project
2. Declaration (by the student)
3. Certificate (of the project guide)
4. Acknowledgement
5. Abstract
   [Provide a brief summary of your project, including its objectives, methods, and key findings.]
6. Table of Contents
   Introduction
   Literature Review
   Methodology
   Results
   Discussion
   Conclusion
   References
7. Introduction
   [Describe the background and context of your project, including the problem statement and objectives.]

8. Literature Review
   [Review relevant literature related to your project, discussing previous research, theories, and concepts.]
9. Methodology/
   [Explain the methods you used to conduct your research or project, including data collection, analysis techniques, and any tools or software used.]
10. Implementation/Software development
11. Results
    [Present the findings of your research or project, using tables, figures, or graphs as needed to illustrate key points.]
12. Discussion
    [Interpret your results and discuss their implications, relating them back to your research objectives and the broader context of your field.]
13. Conclusion
    [Summarize the main findings of your project and their significance, as well as any recommendations for future research or applications.]
14. References
    [List all sources cited in your project using a consistent citation style (e.g., APA, MLA).]

The evaluation pattern of the project will be as follows:

i. Problem formulation and definition
ii. Execution of code & results
iii. Documentation
iv. Clarity in presentation
v. Performance in the Viva voce

Semester I

Core-II-Paper-I (Minor)

Principle of Management

Course Outcomes:

• To understand the basic principles of management.

• To provide a basis of understanding towards working of business organization through the process of management

Unit-1:

Nature of Management: Meaning, Definition, it's nature purpose, importance & Functions, Management as Art, Science & Profession- Management as social System Concepts of management-Administration-Organization. Evolution of Management Thought: Contribution of F.W. Taylor, Henri Fayol, Elton Mayo, Chester Barhard & Peter Drucker to the management thought. Various approaches to management (i.e. Schools of management thought) Indian Management Thought.

Unit-2:

Functions of Management (Part-I) Planning - Meaning - Need & Importance, types levels– advantages& limitations, Forecasting - Need & Techniques, Decision making - Types - Process of rational decision making &techniques of decision making, Organizing - Elements of organizing & processes: Types of organizations, Delegation of authority - Need, difficulties indelegation – Decentralization,

Unit-3:

Functions of Management (Part-II) Staffing - Meaning & Importance, Direction - Nature – Principles, Communication - Types & Importance, Motivation - Importance – theories, Leadership - Meaning - styles, qualities & functions of leaders Controlling-Need, Nature, importance, Process & Techniques, Coordination - Need, Importance.

Unit-4:

Strategic Management

Definition, Classes of Decisions, Levels of Decision, Strategy, Role of different Strategist, Relevance of Strategic Management and its Benefits, Strategic Management in India.

Text Books:

- ✓ Horold Koontz and Iteinz Weibrich, Essential of Management, McGrawhills International
- ✓ K. Aswathapa, Essential of Business Administration, Himalaya Publishing House

Reference Books:

- ✓ L.M. Parasad Principles & practice of management - Sultan Chand & Sons - New Delhi
- ✓ Tripathi, Reddy, Principles of Management, Tata McGraw Hill

Semester II

Core-III-Paper-I (Minor)

Descriptive Statistics

Course Outcomes:

- To understand the concept of population and sample.
- To use frequency distribution to make decision.
- To understand and to calculate various types of averages and variation.

Unit-1

Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample. **Data:** quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio**. Presentation:** tabular and graphical, including histogram.

Unit-2

Measures of Central Tendency: mathematical and positional. **Measures of Dispersion:** range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, absolute moments, factorial moments, skewness and kurtosis, Sheppard's corrections.

Unit-3

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3- variables only), rank correlation. Simple linear regression.

Unit-4

Principle of least squares and fitting of polynomials and exponential curves. Theory of attributes: Independence and association of attributes, consistency of data, measures of association and contingency, Yule's coefficient of colligation.

Text Books:

- ✓ S.C. Gupta, Fundamentals of Statistics, Sultan Chand & sons, Delhi.
- ✓ A.M. Goon, M.K. Gupta and B. Dasgupta, Fundamentals of Statistics, The World Press, Kolkata.

Reference Books:

- ✓ S.P. Gupta, Statistical Methods, Sultan Chand and sons New Delhi

Statistics LAB List of Practicals

1. Graphical representation of data.
2. Problems based on measures of central tendency.
3. Problems based on measures of dispersion.
4. Problems based on combined mean and variance and coefficient of variation.
5. Problems based on moments, skewness and kurtosis. 6. Fitting of polynomials, exponential curves.
7. Karl Pearson's correlation coefficient.
8. Correlation coefficient for a bivariate frequency distribution.
9. Lines of regression, angle between two lines of regression and estimated values of variables.
10. Spearman rank correlation with and without ties.
11. Partial and multiple correlations.
12. Planes of regression and variances of residuals for given simple correlations.

Semester III

Core-II-Paper-II (Minor)

Business Accounting

Course Outcomes:

• To impart the basic business accounting knowledge.

Unit-1

Introduction: Financial Accounting-definition and Scope, objectives of Financial Accounting, Accounting v/s Book Keeping terms used in accounting, users of accounting information and limitations of Financial Accounting.

Conceptual Framework: Accounting Concepts, Principles and Conventions, Accounting Standards concept, objectives, benefits, brief review of Accounting Standards in India, Accounting Policies, Accounting as a measurement discipline, valuation Principles, accounting estimates

Unit-2

Recording of transactions: Voucher system; Accounting Process, Journals, Subsidiary Books, Ledger, Cash Book, Bank Reconciliation Statement, Trial Balance.

Depreciation: Meaning, need & importance of depreciation, methods of charging depreciation.

Unit-3

Preparation of final accounts: Preparation of Trading and Profit & Loss Account and Balance Sheet of sole proprietary business.

Unit-4

Introduction to Company Final Accounts: Important provisions of Companies Act, 1956 in respect of preparation of Final Accounts, Understanding of final accounts of a Company.

Computerized Accounting: Computers and Financial application, Accounting Software packages, An overview of computerized accounting system - Salient features and significance, Concept of grouping of accounts, Codification of accounts, Maintaining the hierarchy of ledger, Generating Accounting Reports.

Text Books :

- ✓ Anil Chowdhry, “Fundamentals of Accounting & Financial Analysis”, Pearson Education
- ✓ Rajesh Agarwal, R. Srinivasan, “Accounting Made Easy”, TMH

Reference Books:

- ✓ Amrish Gupta, “Financial Accounting for Management”, Pearson Education
- ✓ S. N. Maheshwari, “Financial Accounting for Management: Vikas Publishing House

Semester IV

Core-III-Paper-II (Minor)

Business Economics

OBJECTIVES:

• To introduce the economic concepts.

• To familiarize with the students the importance of economic approaches in managerial decision making.

• To understand the applications of economic theories in business decisions.

Unit-1:

Demand, Supply and Market equilibrium: individual demand, market demand, individual supply, market supply, market equilibrium; Elasticity of demand and supply: Price elasticity of demand, income elasticity of demand, cross price elasticity of demand, elasticity of supply; Theory of consumer behavior: cardinal utility theory, ordinal utility theory (indifference curves, budget line, consumer choice, price effect, substitution effect, income effect for normal, inferior and giffen goods), revealed preference theory.

Unit-2:

Producer and optimal production choice: optimizing behavior in short run (geometry of product curves, law of diminishing margin productivity, three stages of production), optimizing behavior in long run (isoquants, isocost line, optimal combination of resources) Costs and scale: traditional theory of cost (short run and long run, geometry of cot curves, envelope curves), modern theory of cost (short run and long run), economies of scale, economies of scope.

Unit-3:

Theory of firm and market organization: perfect competition (basic features, short run equilibrium of firm/industry, long run equilibrium of firm/industry, effect of changes in demand, cost and imposition of taxes); monopoly (basic features, short run equilibrium, long run equilibrium, effect of changes in demand, cost and imposition of taxes, comparison with perfect competition, welfare cost of monopoly), price discrimination, multiplant monopoly; monopolistic competition (basic features, demand and cost, short run equilibrium, long run equilibrium, excess capacity); oligopoly (Cournot's model, kinked demand curve model, dominant price leadership model, prisoner's dilemma)

Unit-4:

Factor market: demand for a factor by a firm under marginal productivity theory (perfect competition in the product market, monopoly in the product market), market demand for a factor, supply of labour, market supply of labour, factor market equilibrium.

Text Books:

- ✓ Yogesh Maheswari, Managerial Economics, PHI Learning, New Delhi.
- ✓ G.S.Gupta, Managerial Economics, Tata Mcgraw-Hill, New Delhi.

Reference Books:

- ✓ Moyer &Harris, Managerial Economics, Cengage Learning, New Delhi.
- ✓ Geetika, Ghosh & Choudhury, Managerial Economics, Tata Mcgrawhill, New Delhi.
- ✓ Dominick Salvatore, Principles of Microeconomics, Oxford University Press, (5th Ed.)

Semester V

Core-II-Paper-III (Minor)

Organizational Behavior

Course Objectives:

• To learn the basic concepts of Organizational Behaviour and its applications in contemporary organizations

• To understand how individual, groups and structure have impacts on the organizational effectiveness and efficiency.

• To appreciate the theories and models of organizations in the workplace

• To creatively and innovatively engage in solving organizational challenges

Course outcomes (COs)

• To understand the conceptual framework of the discipline of OB and its practical applications in the organizational set up

• To deeply understand the role of individual, groups and structure in achieving organizational goals effectively and efficiently

• To critically evaluate and analyze various theories and models that contributes in the overall understanding of the discipline

• To develop creative and innovative ideas that could positively shape the organizations

Unit I

Organizational Behavior: Learning objectives, Definition & Meaning, Why to study OB, An OB model, New challenges for OB Manager LEARNING: Nature of learning, How learning occurs, Learning, Theories of learning- Classical conditioning ,Operant conditioning, social learning, cognitive learning & OB Case Study Analysis

Unit II

PERSONALITY: Meaning & Definition, Determinants of Personality, Personality Traits, Personality & OB PERCEPTION: Meaning & Definition, Perceptual process, Importance of Perception in OB MOTIVATION: Nature & Importance, Herzberg's Two Factor theory, Maslow's Need Hierarchy theory, Alderfer's ERG theory Case Study Analysis.

Unit III

COMMUNICATION: Importance, Types, Barriers to communication, Communication as a tool for improving Interpersonal Effectiveness GROUPS IN ORGANISATION: Nature, Types, Why do people join groups, Group Cohesiveness & Group Decision Making- managerial Implications, Effective Team **Building LEADERSHIP:** Leadership & management, Theories of leadership- Trait theory, Behavioural Theory, Contingency Theory, Leadership & Followership, How to be an Effective **Leader CONFLICT:** Nature of Conflict & Conflict Resolution TRANSACTIONAL ANALYSIS: An Introduction to Transactional Analysis Case Study Analysis

Unit IV

Organizational Culture:

Meaning & Definition, Culture & Organisational Effectiveness HUMAN RESOURCE MANAGEMENT: Introduction to HRM, Selection, Orientation, Training & Development, Performance Appraisal, Incentives ORGANISATIONAL CHANGE: Importance of Change, Planned Change & OB Techniques .

ORGANISATIONAL DEVELOPMENT: Pre-requisites for OD, OD interventions

Text Books

√ Organisation Behaviour- K. Aswathappa- Himalaya Publisher
√ Essential of Organisation Behaviour –Robins –PHP

References

√ Organisation Theory and behavior - S KGupta& R.Joshi-Kalyani Publishers

Semester VI

Core-III-Paper-III (Minor)

Numerical Techniques

OBJECTIVES:

- To learn various numerical techniques.
- To be able to implement different numerical techniques using programming language.

Unit-1

Floating point representation and computer arithmetic, Significant digits, Errors: Round-off error, Local truncation error, Global truncation error, Order of a method, Convergence and terminal conditions, Efficient computations.

Unit-2

Bisection method, Secant method, Regula−Falsi method Newton−Raphson method, Newton's method for solving nonlinear systems.

Unit-3

Interpolation: Lagrange's form and Newton's form Finite difference operators, Gregory Newton forward and backward differences Interpolation Piecewise polynomial interpolation: Linear interpolation.

Unit-4

Numerical integration: Trapezoid rule, Simpson's rule (only method), Newton−Cotes formulas, Gaussian quadrature, Ordinary differential equation: Euler's method Modified Euler's methods, Runge-Kutta second methods

Text books

- ✓ S.S. Sastry, "Introductory Methods of Numerical Analysis", EEE , 5/ed.
- ✓ M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publisher, 6/e (2012)

Reference books

- ✓ Numerical Analysis: J. K. Mantri & S. Prahan, Laxmi Publication.
- ✓ Introduction to Numerical Analysis, Josef Stoer and Roland Bulirsch, Springer.

Practical: Numerical Techniques Lab
Implement using C/ C++ or MATLAB/ Scilab

1. Find the roots of the equation by bisection method.
2. Find the roots of the equation by secant/Regula−Falsi method.
3. Find the roots of the equation by Newton's method.
4. Find the solution of a system of nonlinear equation using Newton's method.
5. Find the solution of tri-diagonal system using Gauss Thomas method.
6. Find the solution of system of equations using Jacobi/Gauss-Seidel method.
7. Find the cubic spline interpolating function.
8. Evaluate the approximate value of finite integrals using Gaussian/Romberg integration.
9. Solve the boundary value problem using finite difference method.