



## SCHEME

### BCA – II/ Second Year (Annual System)

Group	Paper Code	Subject	Internal			Theory	Total	Practical	Grand Total
			3 Months	6 Months	Total				
Group I	BCA-21	Data Structures using C++	5	5	10	40	50	--	100
	BCA-22	Database Management System	5	5	10	40	50	--	
Group II	BCA-23	Internet of Things and Python Programming	5	5	10	40	50	--	100
	BCA-24	Operating System with UNIX /LINUX	5	5	10	40	50	--	
Group III	BCA-25	Accounting and Financial Management	5	5	10	40	50	--	100
	BCA-26	Computer Oriented Numerical Methods	5	5	10	40	50	--	
Group IV	BCA-27	Foundation Course -Same as B.Sc./B. Com./B. A.					100	--	100
Group V	BCA - P28	Practical based on BCA21, BCA22, BCA23 & BCA24	--	--	--	--	--	50	50
TOTAL							400	50	450

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*Ashish Sankar*

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NOTE: General BCA Examination rules are same as B.Sc. (Computer Sc.)/(IT).

In each group student is required to obtain minimum 27 marks in theory and 7 marks in internal assessment to pass.

Pattern of Question papers shall be as given below:

There will be three sections in each paper. All questions from each section will be compulsory.

Section A(5=5\*1): this section will contain 5 objective type questions. One question from each unit of one mark.

Section B(10=2\*5): 5 questions from each unit of 2 marks each with internal choice.

Section C(25=5\*5):5 questions from each unit of 5 marks with internal choice.

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**BCA II YEAR**  
**PAPER-I DATA STRUCTURES USING C++**

**Course Objective:** The paper comprise of programming perception of C++ and the concept of data structure. The basic objective of programming in C++ is to develop a greater understanding of functional, logic, and object-oriented programming paradigms in programming language design and also understanding the design/implementation issues involved with variable allocation and binding, control flow, types, subroutines, parameter passing. The objective of Data Structure is to introduce the concepts of Abstract data Type, performance measurement, time and space complexities of algorithms, to discuss the implementation of linear data structures such as stacks, queues and lists and their applications, non-linear data structures such as trees and graphs, and various sorting and searching techniques.

**Course Outcome:** Understand the use of object-oriented concepts to implement object oriented programs in C++ with applications to encapsulation, inheritance and polymorphism and develop knowledge of basic data structures for storage and retrieval of ordered or unordered data. Data structures include: arrays, linked lists, binary trees, heaps, and hash tables. Students will develop the knowledge of applications of data structures including the ability to implement algorithms for the creation, insertion, deletion, searching, and sorting of each data structure.

**UNIT-I**

Introduction to OOP'S languages, characteristics of OOP's languages, application of OOP's, OOP's paradigm, concepts: object, class, data abstraction, data encapsulation, inheritance and polymorphism. Static and dynamic binding, message passing, benefits of OOP's, disadvantage of OOP's.

**UNIT-II**

**C++ Programming Concepts:** input and output in C++, functions in C++- value parameters, reference parameters, Parameter passing, function overloading, arrays, pointers, new and delete operators, class and object, access specifiers, friend functions, constructors and destructors, Operator overloading, Inheritance and Polymorphism.

**UNIT-III**

**Basic Concepts** – Data Structures, Algorithm Specification-Introduction, Recursive algorithms, Data Abstraction, Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega and Theta notations, Complexity Analysis Examples, Introduction to Linear and Non Linear data.

**Stack:** Definition, Array implementation of stack (static stack): Operations PUSH, POP, And TRAVERSE. Applications of stack: Infix, Prefix, Postfix. **Queue:** Definition, Array implementation of queue (static queue): Operations INSERT, DELETE and TRAVERSE. Introduction to Circular queue: Definition & implementation, Priority queue, Double ended queue, Applications of queue.

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## UNIT-IV

**Introduction to linked list:** Definition, advantaged, basic operations on linked list, stacks and queues using linked list, doubly linked list, circular linked list, applications of linked list.  
**Searching and Sorting Techniques:** Sequential search, binary search, insertion sort, selection sort, quick sort, bubble sort, heap sort, comparison of sorting methods.

## UNIT-V

**Tree:** Trees-basic terminology, binary trees, tree representations as array and linked list, basic operations on binary tree, traversal of binary trees:- inorder, preorder, postorder, applications of binary tree, Threaded binary tree, AVL tree. **Graphs:** Definition, Terminology, Directed, Undirected and Weighted Graph, Representation of Graph, Graph Traversal-Depth first, Breadth first search, Spanning tree, Minimum Spanning tree, Shortest path algorithm.

## TEXT BOOKS

1. Object Oriented Programming with C++, Balaguruswamy, Tata McGraw Hill (2008).
2. Object Oriented Programming in C++, Robert Lafore, Sams; 4<sup>th</sup> edition.
3. Yedidyah Langsam Moshe J. Augenstein, Aaron M. Tenenbaum, “**Data Structures using C & C++**”, PHI
4. G.S.Baluja, “**Data Structures Through C++**”,Dhanpat Rai& Co., 4<sup>th</sup> Edition
5. Fundamentals of Data Structures by Sartaj Sahani.

## REFERENCE BOOKS

1. Seymour Lipschutz,“**Data Structures**”, Schaum’s Outline Series, Tata McGrawHill.
2. Adam Drodzok, “**Data Structures & Algorithm in C++**”, 2nd Edition

## List of Practical

1. Display int, float, char and string using cin and cout.
2. Program to add two numbers.
3. Program to check eligibility to admission.
4. Program to check whether entered number is even or odd.
5. Program to check percentage and grade of a student.
6. Program to print days of week.
7. Program to calculate sum of digits of entered number.
8. Program to check that given number is palindrome or not.
9. Program to calculate area of rectangle, triangle and sphere using function overloading.
10. Program to access private members of a class using member function.
11. Program to implement multilevel inheritance.
12. Program to implement multiple inheritance.
13. Program to read values using constructors.
14. Program to declare default argument in constructor to obtain power of a number.
15. Program to implement multiple virtual baseclass.
16. Program to declare pure virtual function.
17. Implementation of stack using array.
18. Implementation of queue using array.
19. Insertion, deletion and traversal of singly link list.
20. Insertion, deletion and traversal of doubly link list.
21. Program for linear and binary search.
22. Sorting: selection, bubble, insertion and quick sort.

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Ashish Sankar

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J. Deep

Kushal

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**BCA II YEAR**  
**PAPER-II DATABASE MANAGEMENT SYSTEM**

**Course Objective:** To give knowledge of the Relational Model of Data Management. This course contains approaches to organize, store, retrieve and process data, architecture and design techniques for effective implementation, different anomalies and their solutions and a platform for understanding of SQL and PL/SQL.

**Course Outcome:** Student will be able learn database creation and modification. Data definition, manipulation, control using SQL command. They will learn the concepts of joining the database which will help them access data from different relations. Students will be able to implement the programming using PL/SQL for automated and fast database activities.

**UNIT-I**

Purpose of database system, views of data, data models: relation, network, hierarchical, instances and schemas, data dictionary, types of database languages, structure of DBMS, advantages and disadvantages of DBMS, 3-level architecture proposal: external, conceptual & internal levels, levels of data abstraction, Database users and DBA, Classification of Database Management Systems, Components of database system, Traditional File Systems vs. Modern Database Systems, Applications of DBMS, Data Independence.

**UNIT-II**

**Entity relationship model as a tool of conceptual design:** entities & entities set, relationship, relationship set & relationship types, attributes, role, participation and mapping constraints, keys, strong and weak entities, Advance ER Model Features: generalization, specialization & aggregation. **Fundamentals of set theoretical notations:** relations, domains, attributes, tuples.

**UNIT-III**

**Concept of keys:** primary key, super key, alternate key, candidate key, foreign key. **Fundamentals of integrity rules:** Entity & referential integrity ,extension and intention. **Relational Algebra:** select, project, Cartesian product,types of joins: theta, equi, natural, outer joins, Set Operations. **Relational Calculus:** Tuple Relational Calculus, Domain Relational Calculus.Codd's Rule.

**UNIT-IV**

Functional Dependencies, Good & Bad Decomposition and Anomalies as a database: A consequences of bad design, Universal relation, Normalization: 1NF, 2NF, 3NF &BCNF normal forms, multivalued dependency, join dependency, 4NF, 5NF. **SQL Statement:** DDL, DML, DCL, TCL. **Character Function:** Upper, Lower, Initcap,Lpad, Rpad, Ltrim,, Rtrim, Substr, instr, concate. **Number Function:** Ceil, Floor, Round, Trunc, Power, Sign, Abs, Mod. **Date Function:**Sysdate, Months\_between, add\_months, Last\_day, Next\_date.

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## UNIT-V

**Group function:** Min, Max, Avg, Count, Sum. **Conversion Function:** To\_char, to\_date, To\_number. **Sorting Data:** Order by(Ascending and Descending). **Filter Data:** Where Cluase. **Pattern Matching:** Like, Not Like. **Range Search:** Between, Not Between, Using Relation Operator. **Sub Query:** Single Row and Multi Row. **Handing Null:** Is null , Is not null, NVL(). Group by and Having Clause. **Constraints:** Primary Key, Unique Key, Null, Check, Foreign key. **PL/SQL:** Program Structure, Oracle Data types, Named Block, Looping and Decision Making, Unnamed Block, Stored Function, Stored Procedure, Cursor, Packages, Trigger, and Exception Handling.

### Text Books

1. Database System Concepts by Henry Korth and A. Silberschatz.
2. Simplified approach to DBMS, Prateek Bhatia, Gurvinder Singh Kalyani Publication
3. Database Management System by Seema Kedar, Technical Publication

### Reference Books

1. An Introduction to Database System by BipinDesa
2. An Introduction to Database System by C.J.Date.
3. AtulKahate, "Introduction to Database Management Systems".
4. Raghu Ramakrishnan, "Database Management Systems".
5. G.K.Gupta, "Database Management Systems", Tata McGraw Hill, 2011.

### SQL:

1. Create table employee with column id, name, dob, designation, salary. Insert 10 rows.
2. Create table salesman with fields: num, name, city, commission. Insert into 10 rows.
3. Create table customer with field: num, name, city, rating, num. insert 5 row.
4. Update data commission 500 rs if rate is less 5.
5. Change the table structure employee, add new column address, drop column designation and add column post. Rename the column commission to comm of table salesman. Display the name of following student a) Started with 'A'. b) Ended by 'S' c) name contains word 'F' except start and end. d) Second letter is 'E';
6. Display the name of following student: a) Commission is between 500 to 3000 b) Salary is less than 5000. c) Date of birth is greater than 10-May-1991. d) Salary is greater than 5000 d) rating is 10 e) 10 % of salary.
7. Display the name of following student: a) Name is ascending order and descending b) name of employees from the same city c) name of employees from the same city having average salary 10000.
8. Perform group function: sum, count, min, max, avg.
9. Perform date function: sysdate, add\_months, months\_between, last\_day(), Next\_day()
10. Perform Set operation: Union, Minus, Intersect.
11. Add primary key, unique key, check constraints, null constraints in employee.
12. String: Character, CHR, concat, initcap, lenth, lower, upper, lpad, rpad, Rtrim, ltrim, substr, '
13. Number: abs, ceil, floor, round, sign, trunc, power, sqrt,

### PL/SQL

1. Write unnamed program block to add two number.

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2. Write a stored procedure to compare three number and display largest number.
3. Write a function to check whether the given number is prime or not.
4. Write a procedure to implement case statement. Create a calculator, which will perform Five operation: Addition, Subtraction, Multiplication, Division and Implement Zero\_Divide exception.
5. Write procedure to print odd number between 1 to 100 using for loop.
6. Write a procedure named ascursor\_testing. Create a cursor named with First\_cursor fetch and display the all the data from emp table. Implement too\_many\_rows and no\_data\_found exception.
7. Write trigger to restrict delete and insert operation on EMP table.
8. Write procedure to printFibonacci series using and implement user defined exception.
9. Create a package Student Name\_library and put all your procedure and function into package.

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Ashish Sankar

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**BCA – II YEAR**  
**PAPER-III INTERNET OF THINGS AND PYTHON PROGRAMMING**

**Course objective:** The course is designed to acquire basic programming and object-oriented skills in python. Also the course is intended to familiarize students with *Arduino as IDE, programming* language & platform and focusing to make them understand product design and prototyping in Internet of Things.

**Course outcome:** After the completion of the course, the students will be able to design Smart System applications using *Arduino* boards and *basic* components. The students will also be able to solve real life problems using various libraries of Python.

**UNIT-I**

Introduction, types of Arduino, Explore Arduino IDE: File(New, Open, Open Recent, Examples, Close, Save, Save as, Page Setup, Print, Preference), Edit(Undo, Redo, Cut, Copy, Paste, Select All, Find), Sketch(Verify/Compile, Upload, Show Sketch Folder, Include Library), Tools (Auto Format, Archive Sketch, Fix Encoding and Reload, Serial Monitor, Serial Plotter, Board, Port, Get Board Info).

**UNIT-II**

Variables, Data types, collecting and showing data through serial port, Strings and operations with strings, Operators and loops, Exploring Arduino Uno: USB port, External power jack, Analog pins, Digital pins, ICSP (In Circuit Serial Programming), Microcontroller, reset button, Connecting Arduino to PC. Main functions: setup () function, loop () function. Installing package.

**UNIT-III**

What is Python, Python Features, Python Applications, Python and PyCharm Installation, Python IDE, Python Code Basics- Python Variables, Python Data Types (Lists, Tuples, Sets, Dictionary, Strings, Numeric), Python Operators, Python Conditional Statements (If Statement, Elif Statement, Else Statement, Python Loops (While Loop, For Loop, Nested Loop), I/O Operations.

**UNIT-IV**

Python Functions, Uses of Functions, File Handling (Open File, Read / Write File, Close File), Object and class (defining a class, creating an object), `_init_()`, object methods, self parameter.

**UNIT-V**

Python NumPy- array(one, multi-dimensional ), NumPy array vs list, NumPy operations (ndim, iemsze, dtype, reshape, slicing, linspace, max/min, addition, vertical and horizontal stacking, ravel). Python Matplotlib, types of plot, Python Pandas, Pandas Operations: (Slicing the data frame, Merging & Joining, Concatenation, Changing the index, Change Column headers, Data munging.

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## Text Books:

- Learning C for Arduino by Syed Omar Faruk Towaha.
- Learning Python by Mark Lutz, O'Reilly Publication, 5<sup>th</sup> Edition
- Python Programming for beginners by Jason Cannon, Createspace Independent Publishing platform, 2014

## List of practical

### Arduino

1. Write a program to Blink LED using Arduino IDE.
2. Write a program to take input from button (Micro-switch) using Arduino IDE.
3. Write a program to take Analog input from DHT sensor using Arduino IDE.
4. Write a program to demonstrate switch-case with the IR sensor using Arduino IDE.
5. Write a program to display Text on LCD (16\*2) Display using Arduino IDE.

### Python

1. Write a program which will find factors of given number and find whether the factor is even or odd. Hint: Use Loop with if-else statements
2. Write a code which accepts a sequence of words as input and prints the words in a sequence after sorting them alphabetically. Hint: In case of input data being supplied to the question, it should be assumed to be a console input.
3. Write a program, which will find all the numbers between 1000 and 3000 (both included) such that each digit of a number is an even number. The numbers obtained should be printed in a comma separated sequence on a single line. Hint: In case of input data being supplied to the question, it should be assumed to be a console input. Divide each digit with 2 and verify if it is even or not.
4. Write a program that accepts a sentence and calculate the number of letters and digits. Suppose if the entered string is: Python0325 Then the output will be: LETTERS: 6 DIGITS: 4. Hint: Use built-in functions of string.
5. Design a code which will find if the given number is a Palindrome number or not. Hint: Use built-in functions of string.
6. A website requires a user to input a username and password to register. Write a program to check the validity of the password given by the user. Following are the criteria for checking the password:
  - At least 1 letter between [a-z]
  - At least 1 number between [0-9]
  - At least 1 letter between [A-Z]
  - At least 1 character from [\$#@]
  - Minimum length of transaction password: 5. Maximum length of transaction password: 12
7. Write a for loop that prints all elements of a list and their position in the list. `a = [4,7,3,2,5,9]`.
8. Please write a program which accepts a string from console and print the characters that have even indexes.

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9. Please write a program which accepts a string from console and print it in reverse order.
10. Please write a program which count and print the numbers of each character in a string input by console.
11. With two given lists [1,3,6,78,35,55] and [12,24,35,24,88,120,155], write a program to make a list whose elements are intersection of the above given lists.
12. By using list comprehension, please write a program to print the list after removing the value 24 in [12,24,35,24,88,120,155].
13. By using list comprehension, please write a program to print the list after removing the 0th,4th,5th numbers in [12,24,35,70,88,120,155].
14. By using list comprehension, please write a program to print the list after removing delete numbers which are divisible by 5 and 7 in
15. Write a program to compute  $1/2+2/3+3/4+\dots+n/n+1$  with a given n input by console ( $n>0$ ).

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**BCA II YEAR**  
**PAPER-IV OPERATING SYSTEM with UNIX/LINUX**

**Course Objective:** The course is intended as a general introduction to the techniques used to implement operating systems and related kinds of systems software. To familiarize with main structure of Operating System and their working and understand the operations performed by Operating System. The objective is to learn the different memory management techniques and various scheduling policies of Operating system.

**Course Outcome:** Students will learn various concepts and features of Operating systems and will be able to compare various operating systems. Students will learn algorithm of CPU Scheduling, Memory Scheduling and disk scheduling.

**Unit I**

Introduction to Operating Systems, Operating System Services, Functions of Operating System, Types of Operating System, Multiprogramming, Time-sharing system, Storage Structures, System Calls, Multiprocessor System. Basic Concepts of CPU Scheduling, Scheduling Criteria, Scheduling Algorithms, Algorithm Evaluation, Multiple Processor Scheduling, Real-time Scheduling, I/O devices organization, I/O buffering.

**Unit II**

Process Concept, Process Scheduling, Operations on Processes, Threads, Inter-Process Communication, Precedence Graphs, Critical Section Problem, Semaphores, Classical Problems of Synchronization. Deadlock: Deadlock Problem, Deadlock characterization, Deadlock prevention, Deadlock avoidance, Deadlock Detection, Recovery from Deadlock, Methods for Deadlock Handling.

**Unit III**

Concepts of Memory Management, Logical and Physical Address Space, Swapping, Memory Allocation Techniques: Contiguous and Non-contiguous Allocation, Paging, Fragmentation, Segmentation, Segmentation Architecture, Concepts of Virtual Memory, Demand Paging, Page Replacement Algorithms: FIFO, OPR, LRU, Thrashing, Directory Structure, Free Space Management, Disk Scheduling: FCFS, SSTF, SCAN, C-SCAN, LOOK.

**Unit IV**

Linux Operating System, Philosophy, File System, Types of File, Structure of file system, shell layers, Linux Commands: General Purpose Utilities: banner, cal, date, echo, printf, passwd, who, tty, stty, File System Commands: pwd, cd, mkdir, rmdir, ls, Handling Ordinary File Commands: cat, cp, rm, mv, more, file, wc, cmp, comm, diff, lp commands. Pattern Matching, pipes, tee, Simple Filters: head, tail, cut, paste, sort, join, grep, vi editor.

**Unit V**

**The Process:** The Shell Process: Parents and Children, wait, ps: Process Status, System Processes, Running Multiple Jobs: Foreground and Background, nice: Job Execution with Low

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Priority, kill: Premature Termination of Process, Job Control, cron: Running Jobs Periodically, time: Timing Processes set and shift statement, **Programming with Shell Script:** Comment, Shell Variable, Operators, Arithmetic Expansion, Control Structure, Functions, execution, script termination.

**TEXT BOOK:**

1. Operating System Concepts, Addison Wesley, 4th Edition, A. Silberschatz and P. Galvin. 1994.
2. Sumitabha Das, “Unix : Concepts and Applications”, Third Edition, 2006, Tata Mc-Graw Hill
3. Modern Operating System, A.S Tanenbaum., Prentice Hall of India
4. Operating System by Deitel

**REFERENCE BOOK:**

1. Maurice J. Bach, “Design of the Unix Operating System”, Third Edition, 2000, PHI.
2. ISRD Group, Basics of OS, UNIX and SHELL Programming” TMH (2006)
3. A User guide to unix system”, Thomas Rebecca yate, Second Edition, 2002., Tata McGraw Hill.
4. Stephen Prata “Advanced Unix -A programmer’s Guide.

**LIST OF PRACTICAL**

- [1] Write a shell script program to display “HELLO WORLD”.
- [2] Write a shell Script program to check whether the given number is even or odd.
- [3] Shell script to create a simple calculator that performs basic arithmetic operations.
- [4] Calculate area of circle.
- [5] Calculate Simple Interest.
- [6] Copy contents from one file to another file.
- [7] Find greatest number among three numbers.
- [8] Print reverse of an input number.
- [9] Enter marks and basic information of student and print marksheet.
- [10] Print list of prime number between a range entered by user.

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**BCA – II YEAR**  
**PAPER-V ACCOUNTING AND FINANCIAL MANAGEMENT**

**Course Objective:** This course will expose students to a broad range of accounting concepts and their terminology. This will prepare the learners for a mix of accounting professional activities including public accounting, governmental accounting and corporate accounting and will make aware with the financial statements in accordance with the accepted accounting principles.

**Course Outcome:** This course will impart knowledge and understanding of the principle and concepts of financial accounting and develop the skill required for the preparation of financial statement and accounts of various business and companies.

**UNIT-I**

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.

**UNIT-II**

Conceptual Frame work: 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-III**

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.(WDV & SLM).

**UNIT-IV**

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

**UNIT-V**

Computerised 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.

**Recommended Books:**

1. Fundamentals of Accounting & Financial Analysis: By Anil Chowdhry (Pearson Education)
2. Financial accounting: By Jane Reimers (Pearson Education)
3. Accounting Made Easy: By Rajesh Agarwal& R Srinivasan (Tata McGraw –Hill)
4. Financial Accounting for Management: By Amrish Gupta (Pearson Education)
5. Financial Accounting for Management: By Dr. S. N. Maheshwari (Vikas Publishing House).

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**BCA II YEAR**  
**PAPER-VI COMPUTER ORIENTED NUMERICAL METHODS**

**Course Objective:** The primary objective of this course is to make understand numerical computation which include linear equation, interpolation, and differential equation there by understanding the implementation of the numerical methods.

**Course Outcome:** Students will be able to use numerical methods for solving numerical problem, to get the accuracy, to assess the reliability of the numerical results, to determine the effect of round off error or loss of significance.

**UNIT-I**

Representation of Numbers- Integer Representation, Significant Digits, Floating point Representation, Errors in Computing. Roots of Nonlinear Equations: Bisection Method, False Position Method, Newton Raphson Method, Secant Method.

**UNIT-II**

Direct and Iterative Solution of Linear Equations: Basic Gauss Elimination Method, Gauss Jordan Method, LU Decomposition Method, Jacobi Iteration Method, Gauss Siedal Method.

**UNIT-III**

Curve Fitting: Lagrange Interpolation Polynomial, Newton Divided Difference Interpolation Polynomial, Newton-Gregory Forward Difference Formula, Newton-Gregory Backward Difference Formula.

**UNIT-IV**

Numerical Differentiation and Integration: Differentiating Tabulated Functions (First Derivatives of 3 point Forward, Backward and Central Difference formula), Differentiating Higher Order Derivatives (Second Derivatives of 3 point Forward, Backward and Central Difference formula). Newton-Cotes Methods - Trapezoidal rule(Simple and Composite), Simpson's 1/3 rule(Simple and Composite), Simpson's 3/8 rule, Higher Order Rules- Boole's rule.

**UNIT-V**

Numerical Solution of Ordinary Differential Equations: Taylor Series Method, Picard's Method, Runge-Kutta Methods- First Order, Second Order and Classical Fourth Order.

**TEXT BOOK:**

1. Numerical Methods by E Balaguruswamy
2. V. Rajaraman, Computer Oriented Numerical Methods, Prentice Hall, India.

**REFERENCE BOOKS:**

1. S. S. Sastry, Introductory Methods of Numerical Analysis.
2. M. K. Jain, S.R.K. Iyengar & R. K. Jain, Numerical Methods for Scientific and Engineering Computation.
3. H. C. Saxena, Finite Differences and Numerical Analysis.
4. Modes A., Numerical Analysis for Computer Science.
5. Numerical Analysis by Shastri
6. Computer based Numerical Algorithm by Krishnamurthy

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