

# **B. Sc. Syllabus**

**(Academic year 2018-2019 onwards)**

**B.Sc. Computer Science Degree Course**  
**UG - SCHEME OF EXAMINATIONS: CBCS PATTERN**  
(For the students admitted during the academic year 2018-2019 and onwards)

Part	Sub Code	Title of the Paper	Hrs. (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext- Min.	Total Pass Mark	Credits
<b>Semester – 1</b>									
I	18TAM11L	<b>Part-I:</b> Language: Tamil I	6	25	75	100	30	40	3
II	18ENG12L	<b>Part-II:</b> English I	6	25	75	100	30	40	3
III	18BCS13C	<b>Core 1 : Digital Computer Fundamentals</b>	4	25	75	100	30	40	3
III	18BCS14C	<b>Core 2 : Problem Solving and Python Programming</b>	3	25	75	100	30	40	2
III	18BCS15P	<b>Core Practical 1 : Python Programming Lab</b>	3	40	60	100	24	40	2
III	18BCS16A	<b>Allied – 1: Statistics and Numerical Methods</b>	6	25	75	100	30	40	3
IV	18ENV1GE	<b>Environmental Studies</b>	2	25	75	100	30	40	2
			30			700			18
<b>Semester – II</b>									
I	18TAM21L	<b>Part-I:</b> Tamil II	6	25	75	100	30	40	3
II	18ENG22L	<b>Part-II:</b> English II	6	25	75	100	30	40	3
III	18BCS23C	<b>Core 3: C Programming</b>	5	25	75	100	30	40	4
III	18BCS24P	<b>Core Practical 2: C Programming Lab</b>	5	40	60	100	24	40	3
III	18BCS25A	<b>Allied – 2: Discrete Mathematics</b>	6	25	75	100	30	40	3
IV	15VAL2GE	<b>Value Education– Gandhian Thoughts</b>	2	25	75	100	30	40	2
			30			600			18

Part	Sub Code	Title of the Paper	Hrs (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext- Min.	Total Pass Mark	Credits
<b>Semester – III</b>									
III	18BCS31C	<b>Core 4 : Computer System Architecture</b>	5	25	75	100	30	40	3
III	18BCS32C	<b>Core 5 : Data Structures</b>	5	25	75	100	30	40	3
III	18BCS33C	<b>Core 6 : Object Oriented Programming with C++</b>	5	25	75	100	30	40	3
III	18BCS34P	<b>Core Practical 3 : C++ Programming Lab</b>	3	40	60	100	24	40	2
III	18BCS35P	<b>Core Practical 4 : Assembly Language Programming Lab</b>	2	40	60	100	24	40	2
III	18BCS36A	<b>Allied – 3 : Operations Research</b>	6	25	75	100	30	40	3
IV	18BCS37S	<b>Skill Based Subject – I: Micro Processor &amp; Assembly Language Programming</b>	4	25	75	100	30	40	3
			30			700			19
<b>Semester – IV</b>									
III	18BCS41C	<b>Core 7 : Software Engineering</b>	5	25	75	100	30	40	4
III	18BCS42C	<b>Core 8 : Database Management System</b>	5	25	75	100	30	40	4
III	18BCS43C	<b>Core 9 : Java Programming</b>	5	25	75	100	30	40	4
III	18BCS44P	<b>Core Practical 5 : Java Programming Lab</b>	3	40	60	100	24	40	3
III	18BCS45P	<b>Core Practical 6 : DBMS Lab (SQL)</b>	2	40	60	100	24	40	2
III	18BCS46A	<b>Allied – 4 : Business Accounting</b>	6	25	75	100	30	40	5
IV	18BCS47S	<b>Skill Based Subject – II: Principles of System Software</b>	4	25	75	100	30	40	3
V	18EXA4GE	<b>@Extension Activities: NCC/NSS/SPORTS//YRC</b>	-	-	-	-	-	-	1
			30			700			26

Part	Sub Code	Title of the Paper	Hrs (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext- Min.	Total Pass Mark	Credits
<b>Semester – V</b>									
III	18BCS51C	<b>Core 10: Operating System</b>	6	25	75	100	30	40	5
III	18BCS52C	<b>Core 11 : Computer Networks</b>	6	25	75	100	30	40	5
III	18BCS53C	<b>Core 12:HTML and Java Script</b>	6	25	75	100	30	40	5
III	18BCS54P	<b>Core Practical 7 :HTML and Java Script Lab</b>	3	40	60	100	24	40	3
III	18BCS55P	<b>Core Practical 8 : Linux Shell Programming Lab</b>	2	40	60	100	24	40	2
IV	18BCS56S	<b>Skill Based Subject – III: Computer Graphics</b>	4	25	75	100	30	40	3
IV	18BCS5EL	<b>Non-Major Elective Paper – I: ( Office Automation )</b>	3	25	75	100	30	40	2
			30			700			25
<b>Semester – VI</b>									
III	18BCS61C	<b>Core 13 : Visual Basic Programming</b>	6	25	75	100	30	40	6
III	18BCS62C	<b>Core 14 : Artificial Intelligence and Expert system</b>	6	25	75	100	30	40	6
III	18BCS63P	<b>Core Practical 9 : Visual Basic Programming Lab</b>	3	40	60	100	24	40	3
III	18BCS64P	<b>Core Practical 10 :Open Source Computing Lab</b>	2	40	60	100	24	40	2
III	18BCS65V	<b>Project &amp; Viva – Voce</b>	5	20	80	100	32	40	10
IV	18BCS66S	<b>Skill Based Subject – IV: Open Source Computing</b>	5	25	75	100	30	40	5
IV	18BCS6EL	<b>Non-Major Elective Paper – II: Information Technology - 2 E-Commerce and Internet Security</b>	3	25	75	100	30	40	2
			30			700			34
		<b>Total/Credits</b>				<b>4100</b>			<b>140</b>

**@ No External Examinations, Only Continuous Internal Assessment (CIA)**

Includes 25/40 continuous internal assessment marks for theory and practical papers respectively  
Project evaluation done by both Internal and External examiner for 80 Marks

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	DIGITAL COMPUTER FUNDAMENTALS	I	18BCS13C

**Objective:**

- To introduce the basics of Number system and Codes.
- To learn concepts of Logic Gates and Circuits Design
- To minimize number of Gates using Karnaugh map Minimization
- To familiarize the concepts of Data Processing Circuits and Flip Flops
- To introduce HDL

**UNIT – I**

**DIGITAL SYSTEMS AND BINARY NUMBERS:** Digital Systems - Binary Numbers- Number-Base Conversions - Octal and Hexadecimal Numbers - Complements of Numbers - Signed Binary Numbers - Binary Codes - Binary Storage and Registers

**UNIT – II**

**BOOLEAN ALGEBRA AND LOGIC GATES** - Introduction - Basic Definitions - Axiomatic Definition of Boolean Algebra - Basic Theorems and Properties of Boolean Algebra - Boolean Functions - Canonical and Standard Forms - Other Logic Operations - Digital Logic - Integrated Circuits.

**UNIT – III**

**GATE-LEVEL MINIMIZATION** - Introduction - The Map Method - Four-Variable K-Map - Product-of-Sums Simplification - Don't-Care Conditions - NAND and NOR Implementation - Other Two-Level Implementations - Exclusive-OR Function – HDL-Hardware Description Language.

**UNIT – IV**

**COMBINATIONAL LOGIC** - Introduction - Combinational Circuits - Analysis Procedure - Design Procedure - Binary Adder/Subtractor - Decimal Adder - Binary Multiplier - Decoders - Encoders - Multiplexers - HDL Model for Encoder, Decoder, Multiplexer.

**SYNCHRONOUS SEQUENTIAL LOGIC** - Introduction - Sequential Circuits - Storage Elements: Latches - Storage Elements: Flip-Flops – RS, JK, T, D Flipflops

**UNIT – V**

**REGISTERS AND COUNTERS** - Registers - Shift Registers - Ripple Counters - Synchronous Counters - Ring Counters – Johnson Counters

**MEMORY AND PROGRAMMABLE LOGIC** - Introduction - Random-Access Memory - Memory Decoding - Error Detection and Correction - Read-Only Memory - Programmable Logic Array

**TEXT BOOKS:**

1. Morris Mano M, Michael D Ciletti “Digital Design”, Fifth Edition, Pearson, 2013.

**REFERENCES:**

1. Donald P Leech, Albert Paul Malvino and GoutamSaha, “Digital Principles and Applications”, Tata McGraw Hill, 2007.
2. Salivahanan S., Suresh Kumar N, Vallavaraj A., “Electronic Devices and Circuits”, Tata McGraw Hill Co. Ltd., 2008.
3. Mehta V. K., “Principles of Electronics”, S Chand and Company Ltd., 2001.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>PROBLEM SOLVING AND PYTHON PROGRAMMING</b>	<b>I</b>	<b>18BCS14C</b>

**Objective:**

- To introduce the basics of Programming languages
- To introduce the concepts of Python fundamentals
- To introduce the concepts of Control flow and Functions
- To familiarize the concepts of Modules and Packages

**UNIT I**

**PROBLEM SOLVING:** Introduction to Problem Solving- Program development- Analyzing and Defining the Problem - Modular Design – Algorithm - Flow Chart - programming language -Types of programming language - Program Development Environment.

**INTRODUCTION:** Python Interpreter – Program execution – Interactive prompt – IDLE User Interface.

**UNIT II**

**DATA, EXPRESSIONS, STATEMENTS :** values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

**UNIT III**

**CONTROL FLOW, FUNCTIONS:** Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion;

**UNIT IV**

**STRINGS :** string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, exponentiation, sum an array of numbers, linear search, binary search.

**LISTS, TUPLES, DICTIONARIES:** Lists: list operations, list slices, list methods, list loop - Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods.

**UNIT V**

**FILES, MODULES, PACKAGES:** Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions.

**TEXT BOOKS:**

1. Allen B. Downey, ``Think Python: How to Think like a Computer Scientist’’, 2nd edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>)
2. Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

**REFERENCES:**

1. John V Guttag, —Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013



Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	PYTHON PROGRAMMING LAB	I	18BCS15P

**Objective :**

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Read and write data from/to files in Python.

**List of Experiments:**

1. Compute the GCD of two numbers.
2. Find the square root of a number
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Find Mean, Median, Mode of a list of numbers
6. Sorting the numbers in Ascending and Descending order
7. Program for circulate the values of n variables
8. Program for Linear and Binary Search
9. Program for List operations
10. Find First n prime numbers
11. Add, Subtract, and Multiply matrices
12. Programs that take command line arguments (word count)
13. Find the most frequent words in a text read from a file

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	STATISTICS AND NUMERICAL METHODS	I	18BCS16A

**Objective :**

- Learn the basics of Statistics and Numerical Methods.
- Learn the Linear Regression, Curve Fitting
- Learn Numerical methods and Interpolations with Algorithms

**UNIT I**

**Measures of Central Tendency:** Mean, Median and Mode - Relationship among Mean, Median and Mode - Uses, Merits and Demerits - Measures of Dispersion: Range - Quartile Deviation - Mean Deviation - Standard Deviation and Coefficient of Variation.

**UNIT II**

**Skewness:** Meaning - Bowley's and Karl Pearson's Measures of Skewness. Correlation (Two Variable Linear Case): Correlation - Meaning - Scatter Diagram - Types of Correlation - Karl Pearson Correlation Coefficient – Concurrent Deviation Method - Rank Correlation.

**UNIT III**

Linear Regression - Regression Equations for Two Variables - Regression Coefficients - Properties - Simple Problems.

**Curve Fitting:** Linear, Parabola, Exponential and Power Curves.

**UNIT IV**

Numerical Methods - System of Simultaneous Equations: Gauss Elimination-Gauss Jordan, Gauss Siedal Methods with Algorithms - Interpolation : Newton's Forward and Backward Interpolation Formula - Lagrange's Interpolation with Algorithms. (No Derivation, Simple Problems Only).

**UNIT V**

**Numerical Differentiation:** Forward Difference - Backward Difference - Stirling and Bessel's Formula. Numerical Integration: Trapezoidal Rule and Simpson Rule with Algorithms - Solving Ordinary Differential Equations: Taylor's series and Runge-Kutta Method for Numerical Solution of Ordinary Differential Equations with Algorithms.

(No derivation, Simple problems only)

**Text Books:**

1. Fundamental of Mathematical Statistics: S.C. Gupta & V.K. Kapoor, Sultan Chand & Sons, New Delhi.
2. Numerical Methods: P.Kandasamy, K. Thilagavathy, K. Gunavathi, S. Chand & Company Ltd, New Delhi.

3. Numerical Methods in Science and Engineering: M.K.Venkatraman, National Publishing Company, New Delhi.

**Reference Books:**

1. Computer Oriented Numerical Methods - V.Rajaraman
2. Business Statistics – B. R. Vittal, Margham Publications, Chennai.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>C PROGRAMMING</b>	<b>II</b>	<b>18BCS23C</b>

**Objective :**

- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

**UNIT – I**

**Over view of C-**Importance of C-Sample C programs-Basic structure of C programs - **Constants, Variables, and Data Types** - C tokens - Keywords and Identifiers – Constants – Variables-Data types -**Operators and Expressions** – Arithmetic Operators-Relational operators-Logical operators- Assignment operators-Increment and decrement operators-Conditional operator-Bitwise operators - Special operators-Type conversion in expressions-Operator precedence and associativity

**UNIT – II**

**Managing Input and Output Operations** -Reading a character-Writing a character-Formatted input-Formatted output - **Decision Making and Branching**-Decision making with **IF** statement-Simple **IF** statement-The **IF ELSE** statement--The switch statement-The?: Operator-The **GOTO** statement - **Decision Making and Looping**-The WHILE statement-The DO statement-The FOR statement

**UNIT – III**

**Arrays** – Introduction-One dimensional arrays-Two dimensional arrays-Multidimensional arrays. **Character Arrays and Strings**-Declaring and initializing string variables-Reading strings from terminal-Writing strings to screen-Arithmetic operations on characters- Putting strings together- Comparison of two strings – String-Handling functions.

**UNIT – IV**

**User-Defined Functions** – Introduction-Need for user-defined function-The form of C functions- Return values and their types-Calling a function-Category of functions – Recursion-Functions with arrays-The scope and lifetime of variables in functions. **Structures and Unions**-Structure definition- Giving values to members-Structure initialization-Comparison of structure variables-Arrays of structure variables-Arrays within structures-Structures within structures-Structures and functions – Unions-Size of structures-Bit fields.

**UNIT – V**

**Pointers**-Understanding pointers-Accessing the address of a variables-Declaring and initializing pointers-Accessing a variable through its pointer-Pointer expressions-Pointers and arrays-Pointers and character strings-Pointers and functions-Pointers and structures.

**File Management in C**-Defining and opening a file-Closing a file-Input/Output operations on files- Error handling during **I/O** operations-Random access to files-Command line arguments.

**TEXT BOOKS**

1. E.Balagurusamy,"Programming in ANSI C", Seventh Edition McGraw Hill Education India Private Ltd, 2017

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	C PROGRAMMING LAB	II	18BCS24P

**Objective :**

- Be familiar with C programming
- Be exposed to implementing abstract data types
- Learn to use files
- Learn to implement sorting and searching algorithms.

**List of Experiments:**

1. Write a program to find the sum, average, standard deviation for a given set of numbers.
2. Write a Program for the following String operations without using built-in functions  
i) String Copy ii) String Compare iii) String Length  
iv) String reverse v) String Concatenate vi) Palindrome Checking
3. Write a program to generate ‘n’ prime numbers.
4. Write a Program for Matrix addition, Subtraction and Multiplication
5. Write a Program to read a positive integer and reverse it.
6. Write a Program to check whether the given number is an Armstrong number or not
7. Write a program to print the student’s Mark sheet assuming Regno, Name, and Marks in five subjects in a structure. Create an array of structures and print the mark sheet in the university pattern.
8. Write a program that take a paragraph and a number (n) as input and word wraps the text to n characters for each line. Your program must ensure that break the word in half. If the word does not fit within the same line, the word should go to the next line
9. Write a program to perform all manipulations like insertion, deletion and modification in files.
10. Write a program which takes a file as command line argument and copy it into another file. At the end of the second file write i)Number of Characters ii) Number of Words and iii) Number of Lines.
11. Write a program that will print all the reverse the words of a given sentence in-place. For example, if the following is the input “**This is a line of text**” the output will be “**sihT si a enil fo txet**”
12. A factorion is a natural number that equals the sum of the factorials of its decimal digits. For example, 145 is a factorion because  $1! + 4! + 5! = 1 + 24 + 120 = 145$ . Write a program that will print all the factorions below 1000000
13. Write a program that encrypts a given string using mirror characters in the alphabet that is  $a \leftrightarrow z, b \leftrightarrow y, c \leftrightarrow x$  and so on.
14. Write a program that will print all the palindrome words in a given sentence.
15. Abundant Numbers - A number n is said to be an abundant number if the sum of its proper divisors is greater than the number n. For example, 12 is an abundant number  $1 + 2 + 3 + 4 + 6 = 16$ . Write a program that will print all the abundant numbers below 1,000,000

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>DISCRETE MATHEMATICS</b>	<b>II</b>	<b>18BCS25A</b>

**Objective:**

To extend student's Logical and Mathematical maturity and ability to deal with abstraction and to introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems.

**UNIT I**

**Mathematical Logic:** Propositions and Logical Operators - Truth Table –Tautology – Contradiction - Equivalence and Implication - Normal Forms (DNF, CNF, PDNF and PCNF). (Chapter I: Sections: 1.1 – 1.3).

**UNIT II**

**Inference Theory:** Inference Theory for Statement Calculus – Predicates – Quantifiers – Variables - Free and Bound Variables - Inference Theory for Predicate Calculus. (Chapter II: Sections: 1.4- 1.6).

**UNIT III**

**Basic Set Theory:** Basic Definitions - Venn Diagrams and Set Operations - Laws of Set Theory - Principle of Inclusion and Exclusion – Relations - Properties of Relations - Matrices of Relations – Functions - Injective, Surjective and Bijective Functions. (Chapter III: Sections: 2.1, 2.3 and 2.4).

**UNIT IV**

**Formal Languages and Automata:** Languages - Operations on Languages - Regular Expressions and Regular Languages – Grammar - Types of Grammars - Finite State Machine - Finite State Automata. (Chapter IV: Section: 3.3 and Chapter VI: Sections: 6.1 and 6.2).

**UNIT V**

**Graph Theory:** Basic Terminology - Types of Graphs - Paths, Cycle and Connectivity - Representation of Graphs in Computer memory – Trees - Properties of Trees - Binary Trees - Traversing Binary Trees - Computer Representation of General Trees. (Chapter V: Sections: 5.1 and 5.2).

**TEXT BOOK**

1. Discrete Mathematical Structures with Applications to Computer Science, J.P. Tremblay R.Manohar, McGraw Hill International Edition, 1997. (For Unit I, Unit II, Units III and Unit V)
2. Discrete Mathematics, Dr.M.K.Venkataraman, Dr.N.Sridharan, N.Chandarsekaran, The National Publishing Company, Chennai, 2002. (For Unit IV)

**REFERENCE BOOKS:**

Discrete Mathematics, J.K.Sharma, Macmillan India Limited, Second Edition, 2005.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>COMPUTER SYSTEM ARCHITECTURE</b>	<b>III</b>	<b>18BCS31C</b>

**Objective:**

- To make students understand the basic structure and operation of digital computer.
- To understand the hardware-software interface.
- To familiarize the students with arithmetic and logic unit and implementation of arithmetic operations.
- To expose the students to the concepts of Memory Organization.

**UNIT – I**

**Data Representation:** Fixed point representation – Floating point representation – Alphanumeric code.

**Register Transfer and Micro operation:** Register Transfer Language – Register Transfer – Arithmetic Micro operation – Logic Micro operation – Shift Micro operation – Arithmetic Logic Shift Unit.

**UNIT – II**

**Basic Computer Organization and Design:** Instruction Codes – Timing and Control – Computer Register – Instruction Cycle – Input-Output and Interrupt.

**Micro-Programmed Control:** Control Memory – Address Sequencing – Design of Control Unit.

**UNIT – III**

**Central Processing Unit:** General Register Organization – Stack Organization – Instruction Formats – Addressing Modes – Data Transfer and Manipulation – Programmed Control – Reduced Instruction Set Computer – CISC.

**UNIT – IV**

**Computer Arithmetic:** Addition and Subtraction – Multiplication Algorithm – Division Algorithm – Floating-point Arithmetic operation – Decimal Arithmetic Operations.

**Input Output Organization:** Peripheral Devices – Input Output Interface – Asynchronous Data Transfer – Modes of Transfer – Direct Memory Access – Input Output Processor (IOP).

**UNIT – V**

**Memory Organization:** Memory Hierarchy – Main memory – Auxiliary memory – Associative memory – Cache memory – Virtual memory.

**Multiprocessors:** Characteristics of Multiprocessors – interconnection Structures.

**TEXT BOOKS**

1. Computer System Architecture, M. Morris Mano , Third Edition, Pearson, 2007.

**REFERENCE BOOKS**

1. Computer Architecture and Organization, Hayes. J. P., McGraw Hill, 2009.



Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>DATA STRUCTURES</b>	<b>III</b>	<b>18BCS32C</b>

**Objective :**

- To apply advance C programming techniques such as pointers, dynamic memory allocation, structures to develop solutions for particular problems.
- To explain how to choose the appropriate data structure to solve a programming problem
- To compare and contrast the benefits of dynamic and static data structures implementations

**UNIT I : C POINTERS**

Pointers – Arrays and Pointers - Pointers and strings - Pointer and Address Arithmetic –Two Dimensional Arrays and Pointers - Pointers to Functions – Calling Mechanism – Call by value - Call by Pointer - Dynamic Memory Allocation – Structures – Pointer to Structures – Unions – Pointer to Union - Enumeration Types - Bit fields - Files.

**UNIT II ARRAY BASED LINEAR DATA STRUCTURES**

Data abstraction - Abstract Data Types (ADT) - Array ADT - Linear List ADT (Polynomials) - Stack ADT - Queue ADT - Evaluation of expressions.

**UNIT III LINKED LIST BASED LINEAR DATA STRUCTURES**

Singly Linked Lists - Linked Stacks and Queues - Polynomial ADT - Circularly Linked Lists - Doubly Linked Lists

**UNIT IV NON LINEAR DATA STRUCTURES**

Trees - Binary Trees - Traversals - Operations - Threaded Binary Trees - Binary Search Trees - Disjoint Sets

**UNIT V SORTING**

Insertion Sort – Shell Sort – Heap Sort - Merge Sort – Bucket Sort – External Sorting – Multiday Merge – Poly phase Merge – Replacement Selection

**TEXT BOOKS:**

1. PradipDey and Manas Ghosh, —Programming in C, Second Edition, Oxford University Press, 2011.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C|| , Second Edition, University Press, 2008.

**REFERENCES:**

1. Robert Kruse, C.L.Tondo, Bruce Leung, ShashiMogalla , — Data Structures and Program Design in C|| , Second Edition, Pearson Education, 2007
2. Jean-Paul Tremblay and Paul G. Sorenson, —An Introduction to Data Structures with Applications|| , Second Edition, Tata McGraw-Hill, 1991.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>OBJECT ORIENTED PROGRAMMING WITH C++</b>	<b>III</b>	<b>18BCS33C</b>

**Objective:**

- Learn the fundamentals of input and output using the C++ library
- Design a class that serves as a program module or package.
- Understand and demonstrate the concepts of Functions, Constructor and inheritance.

**UNIT – I**

**Principles of Object Oriented Programming:** Software Crisis - Software Evolution - Procedure Oriented Programming - Object Oriented Programming Paradigm - Basic concepts and benefits of OOP - Object Oriented Languages - Structure of C++ Program - Tokens, Keywords, Identifiers, Constants, Basic data type, User-defined Data type, Derived Data type – Symbolic Constants – Declaration of Variables – Dynamic Initialization - Reference Variable – Operators in C++ - Scope resolution operator – Memory management Operators – Manipulators – Type Cast operators – Expressions and their types – Conversions – Operator Precedence - Control Structures

**UNIT – II**

**Functions in C++:** Function Prototyping - Call by reference - Return by reference - Inline functions - Default, const arguments - Function Overloading – Classes and Objects - Member functions - Nesting of member functions - Private member functions - Memory Allocation for Objects - Static Data Members - Static Member functions - Array of Objects - Objects as function arguments - Returning objects - friend functions – Const Member functions .

**UNIT – III**

**Constructors:** Parameterized Constructors - Multiple Constructors in a class - Constructors with default arguments - Dynamic initialization of objects - Copy and Dynamic Constructors - Destructors - Operator Overloading - Overloading unary and binary operators – Overloading Using Friend functions – manipulation of Strings using Operators.

**UNIT – IV**

**Inheritance:** Defining derived classes - Single Inheritance - Making a private member inheritable – Multilevel, Multiple inheritance - Hierarchical inheritance - Hybrid inheritance - Virtual base classes - Abstract classes - Constructors in derived classes - Member classes - Nesting of classes.

**UNIT – V**

**Pointers, Virtual Functions and Polymorphism:** Pointer to objects – this pointer- Pointer to derived Class - Virtual functions – Pure Virtual Functions – C++ Streams –Unformatted I/O- Formated Console I/O – Opening and Closing File – File modes - File pointers and their manipulations – Sequential I/O – updating a file :Random access –Error Handling during File operations –

Command line Arguments.

**TEXT BOOKS**

1. E. Balagurusamy, “Object Oriented Programming with C++”, Fourth edition, TMH, 2008.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	C++ PROGRAMMING LAB	III	18BCS34P

**Objective :**

- Understand the fundamentals of object oriented concepts with C++.
- Be able to write a C++ program to solve various problems.

**LIST OF EXPERIMENTS:**

**DATA STRUCTURES**

1. Implement **LINEAR** and **BINARY SEARCH** to find a particular name in a list of names
2. **Implement Queue**. The following Operations over Queue should be allowed
  - a. Insertion
  - b. Deletion
  - c. Modification
  - d. Listing of elements
3. Implement Stack
4. Write a program for Linked List representation of Employee record and do the following operations using pointers.
  - a. To add a new record
  - b. To delete an existing record
  - c. To print the information about an employee
  - d. Finding the number of employee in the structure
5. Implementation of various Tree Traversals schemes
6. Arrange a set of numbers in **ASCENDING ORDER** using **QUICK SORT**.
7. Arrange a set of numbers in **DESCENDING ORDER** using **HEAP SORT**.

**OBJECTS and CLASSES**

8. Create a Class to implement the data structure STACK. Write a Constructor to initialize the TOP of the Stack to 0. Write a member function PUSH() to insert an element and a member function POP() to delete an element. Check for overflow and underflow conditions.
9. Create a class ARITH which consists of a FLOAT and an INTEGER variable. Write member functions ADD(), SUB(), MUL(), DIV(), MOD() to perform addition, subtraction, multiplication, division and modulus respectively. Write member functions to get and display values.

**OPERATOR OVERLOADING**

10. Create a class MAT has a 2-D matrix and R & C represents the rows and columns of the matrix. Overload the operators +, -, \*, to add, subtract and multiply two matrices. Write member functions to get and display MAT object values.

11. Create a class **STRING**. Write member functions to initialize, get and display strings. Overload the operator **+** to concatenate two strings, **==** to compare 2 strings and a member function to find the length of the string.

### **INHERITANCE**

12. Create a class which consist of **EMPLOYEE** detail like eno, ename, dept, basic salary, grade. Write member functions to get and display them. Derive a class **PAY** from the above class and write a member function to calculate da, hra, pf depending on the grade and display the Payslip in a neat format using console I/O.
13. Create a class **SHAPE** which consist of two **VIRTUAL FUNCTIONS** Cal\_Area() and Cal\_Perimeter to calculate Area and Perimeter of various figures. Derive three classes **SQUARE**, **RECTANGLE** AND **TRIANGLE** from the class **SHAPE** and calculate Area and Perimeter of each class separately and display the result.
14. Create two classes which consist of two private variables, one Integer and one Float variable in each class. Write member functions to get and display them. Write a **FRIEND** function common to both classes which takes the object of the above two classes as arguments and the Integer and Float values of both the objects separately and display the result.

### **CONSOLE I/O**

15. Write a user-defined function **USERFUN ()** which has the formatting commands like setw (), showpoint, showpos, precision (). Write a program which prints an multiplication table and uses **USERFUN ()** for formatting.

### **FILES**

16. Write a program to perform insertion, deletion and update using files.
17. Write a program, which takes a file as argument and copies into another file with line numbers using Command Line Arguments.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	ASSEMBLY LANGUAGE PROGRAMMING LAB	III	18BCS35P

**Objective:**

- To be familiar with Assembly Language
- General structure of an assembly language program
- Introducing Data representation in assembly

**List of Experiments:**

1. Data transfer instructions like:
  - i] Byte and word data transfer in different addressing modes.
  - ii] Block move (with and without overlap)
  - iii] Block interchange
2. Arithmetic & logical operations like:
  - i] Addition and Subtraction of multi precision nos.
  - ii] Multiplication and Division of signed and unsigned Hexadecimal nos.
  - iii] ASCII adjustment instructions
  - iv] Code conversions
  - v] Arithmetic programs to find square cube, LCM, GCD, factorial
3. Bit manipulation instructions like checking:
  - i] Whether given data is positive or negative
  - ii] Whether given data is odd or even
  - iii] Logical 1's and 0's in a given data
  - iv] 2 out 5 code
  - v] Bit wise and nibble wise palindrome
4. Branch/Loop instructions like:
  - i] Arrays: addition/subtraction of N nos.
  - ii] Finding largest and smallest nos.
  - iii] Ascending and descending order
  - iv] Near and Far Conditional and Unconditional jumps, Calls and Returns
5. Programs on String manipulation like string transfer, string reversing, searching for a string, etc.
6. Programs involving Software interrupts
7. Programs to use DOS interrupt INT 21h Function calls for Reading a Character from keyboard, Buffered Keyboard input, Display of String on console

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>OPERATIONS RESEARCH</b>	<b>III</b>	<b>18BCS36A</b>

**Objective :**

- Formulate a real-world problem as a mathematical programming model
- Implement and solve the Game Theory
- Understand the theoretical workings of the simplex method for linear programming

**UNIT I**

**Linear Programming Problem:** Formulation of L.P.P – Graphical solutions of L.P.P – Canonical & Standard forms of LPP – Simplex Method. Duality in L.P.P –Formulation of Duality. Duality and Simplex method – Dual Simplex Method

(Chapter 2: Sections 2:1 -2:4; Chapter 3: Sections 3:1 - 3:5; Chapter 4: Sections 4:1 - 4:3; Chapter 5: Sections 5:1 - 5:4, 5:7, 5:9).

**UNIT II**

**Game Theory:** Two person zero sum game – The Maximin – Minimax principle – Problems. Solution of 2 x 2 rectangular Games – Domination Property – (2 x n) and (m x 2) graphical method – Problems – Dominance Property.

(Chapter 17: Sections 17:1 - 17:7).

**UNIT III**

**The Transportation Problems:** Basic feasible solution by L.C.M – NWC- VAM- Optimum solutions (MODI Method) – Unbalanced Transportation problems. The Assignment Problems – Assignment algorithm – Optimum solutions (Hungarian Method) – Unbalanced Assignment Problems. (Chapter 10: Sections 10:1 - 10:13; Chapter11: Sections 11:1 - 11:4).

**UNIT IV**

**Inventory control:** Types of inventories – Inventory costs – EOQ Problem with no shortages – Production problem with no shortages – EOQ with shortages – Production problem with shortages – EOQ with price breaks. (Chapter 19: Sections 19:1 - 19:12).

**UNIT V**

Network scheduling by PERT / CPM – Introduction – Network and basic components – Rules of Network construction – Time calculation in Networks – CPM. PERT – PERT calculations – Problems.(Chapter 25: Sections 25:1 - 25:8, 30:1 -30:3).

**TEXT BOOKS:**

1. Operations Research, Kandiswarup, P. K. Gupta, Man Mohan, S. Chand & Sons Education Publications, New Delhi, Fourteenth Revised Edition, Reprint 2009.
2. Problems in Operations Research, P. K. Gupta, Man Mohan, S. Chand and Sons Education Publications, Eleventh Edition, Reprint 2007.

**REFERENCE BOOKS:**

1. Operations Research - An Introduction, Hamdy A.Taha, ,EightEdition, Pearson Education, Reprint 2009.
2. Problems in Operations Research, P.K Gupta and D.S. HiraS.Chand and Company Limited, Third Edition, Reprint 2000.
3. Operations Research Theory and Applications, J.K.Sharma, Macmillan India limited Second Edition, Reprint 2002



Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	MICRO PROCESSOR & ASSEMBLY LANGUAGE PROGRAMMING	III	18BCS37S

**Objective:**

- Collected knowledge on Intel 8085 architecture and its addressing modes
- Understood and the concepts of 8-bit processors
- Got the fundamental knowledge of 16-bit processors.
- Familiarity on interfaces and interrupts of Intel 8085
- Known the architecture and functionalities of 8086

**UNIT-I**

Microprocessor Architecture: Intel 8085 - Instruction Cycle - Timing diagram- Instruction Format - Addressing modes - Intel 8085 Instructions.

**UNIT-II**

Programming using 8085: Simple examples - 8-bit addition and subtraction - 16-bit addition - 8-bit decimal subtraction - complements of 8-bit and 16-bit number - shifting bits - - finding largest of two numbers - finding largest and smallest in an array - sum of series of numbers - 8-bit multiplication and division.

**UNIT-III**

Peripheral Devices and Their Interfacing I: Address Space Partitioning -Memory and I/O Interfacing - Interrupts of Intel 8085 - Interfacing Devices and I/O Devices/8255-Programmable peripheral Interface.

**UNIT-IV**

Peripheral Devices and Their Interfacing II: 8253- Programmable Interval Timer, 8259- Priority Interrupt Controller, 8279-Programmable Keyboard/Display Interface, 8251- USART, 8237/8257- Programmable DMA Controller.

**UNIT-V**

8086 Architecture and assembly language Programming: Basic - 8086 Configuration - minimum mode and maximum mode - CPU Architecture - Internal Operation – Machine language Instructions – instruction Execution timing – Assembler instruction format.

**TEXT BOOKS**

1. B. Ram, “Fundamentals of Microprocessors and Microcomputers”, Dhanpat Rai Publications Pvt. Ltd., 1998. Unit I : Chapter 3, 4; Unit II: Chapter 6; Unit III : Chapter 7
2. Y.C. Liu and G.A. Gibson, “Microcomputer Systems: The 8086/8088 family Architecture, programming and Design”, Prentice Hall of India, New Delhi, 1986. Unit IV: Ch 2; Unit V: Ch 3.1 - 3.9, 4.1.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	SOFTWARE ENGINEERING	IV	18BCS41C

**Objective:**

- Understand the phases in a software project
- Understand fundamental concepts of requirements engineering and Analysis Modelling.
- Understand the major considerations for enterprise integration and deployment.
- Learn various testing and maintenance measures

**UNIT- I**

**INTRODUCTION:** Software Engineering – Software Process – Generic Process Model – Prescriptive Process Model – Specialized Process Model – Unified Process – Agile Development – Agile Process – Extreme Programming – Other Agile Process Models – Software Knowledge – Core Principles – Process Framework Activity - Practices .

**UNIT-II**

**REQUIREMENTS ENGINEERING:** Requirements Engineering Tasks – Initiating Requirements Engineering Process – Eliciting Requirements – Negotiating Requirements – Validating Requirements.  
**BUILDING THE ANALYSIS MODEL :** Requirements Analysis – Analysis Modeling approaches – Data Modeling concepts : Data Dictionary – ERD - Flow Oriented Modeling : Data Flow Diagram – Creating a Behavioral Model.

**UNIT- III**

**DESIGN ENGINEERING:** Design Process & Design Quality – Design Concepts – The Design Model: Data Design Elements – Architectural Design Elements – Interface Design Elements – Component level Design Elements – Deployment level Design Elements. Design Tools: HIPO diagram - Structure Chart - Decision Tree - Decision Table - Structured Flowchart – Pseudo code – Nassi-Shneiderman Diagram.

**UNIT-IV**

**SOFTWARE TESTING & IMPLEMENTATION:** Testing Strategies – Testing Tactics – Testing Methodologies and Debugging Methods – System Documentation Manuals - Document review - Software Training - Post Implementation Review - Maintenance Issues - Study of Automated Testing tools.

**UNIT-V**

**UML:** Introduction - Modeling Concepts and Diagrams – Use Case Diagrams – Class Diagrams – Interaction Diagrams – State Chart Diagrams – Activity Diagrams – Package Diagrams – Component Diagrams – Deployment Diagrams

**TEXT BOOK:**

1. Pressman R S, “Software Engineering – A Practitioner’s Approach”, Tata McGraw Hill, 2016.

**REFERENCES:**

1. Ian Sommerville, “Software Engineering”, Pearson Education, 2015.
2. Shari Lawrence Pfleeger and Joanne M. Atlee, “Software Engineering Theory and Practice”, Pearson Education, 2011.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	DATABASE MANAGEMENT SYSTEM	IV	18BCS42C

**Objective:**

- To expose the students to the fundamentals of Database Management Systems.
- To make the students understand the relational model.
- To make the students understand the Security Issues in Databases.

**UNIT-I**

**BASIC CONCEPTS:** Introduction to databases – Conventional file processing – Purpose of database system – Characteristics of database approach – Advantages of using DBMS – Database concept and architecture – Data Abstraction – Data Models – Instances and Schema – Data Independence – Schema Architecture – Components of a DBMS – Database Languages – Database Manager – Database Administrator – Database Users.

**UNIT-II**

**DATA MODELING:** Introduction – Data associations – Entities, attributes, relationships – Constraints – Design of Entity Relationship data models (ERD) – Generalization – Aggregation – Conversion of ERD into tables – Introduction to Network data model and Hierarchical data model.

**FILE ORGANIZATION:** Storage device characteristics – Constituents of a file – Operations on file – Serial files – Sequential files – Index sequential files – Direct files – Binary and Secondary Key Retrieval – Indexing using Tree Structures.

**UNIT-III**

**RELATIONAL MODEL:** Introduction to Relational Data Model – Basic concepts – Enforcing data Integrity constraints – Relational Algebra Operations – Extended Relational Algebra Operations.

**RELATIONAL DATABASE MANIPULATION:** Introduction to Structured Query Language (SQL) – SQL Commands for defining Database, Constructing database, Manipulations on database – Basic data retrieval operations – Advanced Queries in SQL – Aggregation – Updates in SQL.

**UNIT-IV**

**DATABASE DESIGN THEORY:** Data base design process – Relational Database Design – Relation Schema – Anomalies in a database – Functional dependencies – Axioms – closure of a set of FD's – minimal covers – Normal forms based on primary keys – Second Normal form, Third Normal form, Boyce–Codd Normal form.

**UNIT-V**

**DATABASE SECURITY, INTEGRITY CONTROL:** Security and Integrity threats – Defense mechanisms – Transaction and concurrency control mechanisms- ACID properties, Serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, Database recovery management.

**TEXT BOOKS:**

1. Silberschatz A., Korth H. and Sudarshan S., “Database System Concepts”, Tata McGraw Hill, 2011.

2. Elmasri R. and Navathe S.B., “Fundamentals of Database Systems”, Pearson Education, 2016.

**REFERENCE BOOKS :**

1. “Database Management Systems” by Alexis Leon and Mathews Leon.
2. “Database Management Systems “ by Elmasri and Navathe.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	JAVA PROGRAMMING	IV	18BCS43C

**Objective:**

- To introduce the basics of Java Programming and JVM
- To impart Fundamental knowledge in Object Oriented Programming
- Ability to generate simple packages and to design Threads.

**UNIT-I**

Introduction: Benefits of OOPS- Java History-Java Features- Java Virtual Machine - Java Environment- Java Tokens- Constants- Variables- Data Types – Operators and Expressions-Decision Making and Branching- Decision Making and Looping.

**UNIT-II**

Classes, Objects and Methods: Classes and Objects - Constructors- Method Overloading- Static Members-Inheritance- Overriding Methods- Final Variables, Final Methods and Final Classes - Finalize Method- Abstract Methods and Abstract Classes –Visibility Control - Arrays - Strings.

**UNIT-III**

Interfaces, Packages and Thread: Defining Interface- Extending Interfaces Implementing Interfaces – Packages-Multithreaded Programming: Thread Life Cycle - Thread Exceptions – Thread Priority-Synchronization.

**UNIT-IV**

File Handling: Types of Errors – Exceptions- Syntax of Exception Handling Code-Multiple Catch Statements- Using Finally Statements- Managing Input / Output Files in Java: Concept of Streams-Stream Classes- Character Stream - Classes-Reading / Writing Characters- Reading / Writing Bytes- Handling Primitive Data Types- Random Access files.

**UNIT-V**

AWT and Applet: Event Handling Methods- Labels- Button Control- Check Box Control- Radio Button Control- Choice Control- List Control-Flow Layout- Border Layout-Grid Layout – Menus-Mouse Events-Applets: Life cycle of an Applet-Development and Execution of a Simple Applet.

**TEXT BOOKS**

1. E. Balagurusamy, “Programming with JAVA”, Tata McGraw Hill, New Delhi, 4th edition. Units- I, II, III and IV
2. C. Muthu, “Programming with JAVA”, Vijay Nicole Imprints Private Limited, Chennai, Second Edition, 2011. - Unit-V

**REFERENCE BOOKS**

1. PatricNaughton, and Herbert Schildt “Java - The Complete Reference” Tata McGraw Hill Publishers, 2011

<b>Year</b>	<b>Subject Title</b>	<b>Sem.</b>	<b>Sub Code</b>
<b>2018 -19 Onwards</b>	<b>JAVA PROGRAMMING LAB</b>	<b>IV</b>	<b>18BCS44P</b>

**Objective:**

- To Understand and to implement various programming techniques of Java.
- Be able to use Java SDK environment to create, debug and run Java programs.

**Experiments that uses the following Concepts:**

1. Classes and Objects
2. Constructors
3. Inheritance
4. Method Overloading and Method Overriding
5. Interface
6. Exceptions handling
7. Packages
8. Multithreading
9. Input / Output streams
10. AWT Controls
11. Applet

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	DBMS LAB (SQL)	IV	18BCS45P

**Objective:**

- To give a good formal foundation on the relational model of data.
- To present SQL and procedural interfaces to SQL comprehensively.
- To present the concepts of Triggers and stored procedures.
- To present and developing a Package using a Database.

**List of Experiments:**

**SQL – ORACLE**

1. Working with DDL and DML commands of SQL for creation and manipulation of single, multiple tables.
2. Working with PL/SQL, Triggers and stored procedures.
3. Embedded SQL
4. Developing a Package using a database.



Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	BUSINESS ACCOUNTING	IV	18BCS46A

**Objective:**

- To introduce the basics of Business Accounting.
- To knowledge of Journal and Ledger accounting.
- To familiarize the concepts of balance sheet and Purchase books.

**UNIT- I**

Accounting – definition and functions – accounting conventions concepts – systems of accounting – rules for double entry system of books keeping – preparation of journal and ledger accounting.

**UNIT- II**

Subsidiary books – purchase books – sales books – purchase returns books - sales return books – cash books.

**UNIT- III**

Preparation of trial balance (**except errors**) – final accounts – manufacturing, trading, profit and loss accounts and balance sheet with simple adjustments.

**UNIT- IV**

Depreciation – methods of depreciation – straight line method and diminishing balance method. Cost accounting– elements of costing – type of costing – preparation of sample cost sheets.

**UNIT- V**

Pricing of material issued – FIFO-LIFO, Simple and weighted– average methods. Labour cost accounting – calculation of wages and over time payable to workers – individual bonus plans – Halsay system and Rowan system.

**NOTE:** 60% of the question should be related to problems and 40% relating to theory question.

**TEXT BOOKS**

1.T.S.Grewal “Double Entry Books Keeping”, Sultan Chand & Sons Publ.

2.S.P.Jain&K.L.Narang, “Cost Accounting Principles and Practice”, 13<sup>th</sup> Edition, Kalyani Publ.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>PRINCIPLES OF SYSTEM SOFTWARE</b>	<b>IV</b>	<b>18BCS47S</b>

**Objective :**

- To understand the Concept of system software and Compiler
- To understand the process of scanning and parsing.
- To know the design and implementation of assemblers, macro processor, linker and compiler.
- To have an understanding of loader, system software tools.
- To understand and know the working of Loader

**UNIT-I**

**LANGUAGE PROCESSORS:** Language Processing Activities – Fundamentals of Language Processing – Fundamentals of Language Specification – Language Processor Development Tools.

**UNIT-II**

**ASSEMBLERS AND MACRO:** Elements of Assembly Language Programming – Overview of Assembly Process - Design of a Two – Pass Assembler - Macro Definition and Call – Macro Expansion – Nested Macro Calls.

**UNIT-III**

**COMPILER I :** Scanning: Finite State Automate – Regular Expressions – Building DFA – Performing Semantic Action – Writing a Scanner – Parsing: Parse Tree and Abstract Syntax Trees – Top Down Parsing – Bottom-Up Parsing.

**UNIT-IV**

**COMPILER II AND INTERPRETERS:** Aspects of Compilation –Memory Allocation - Compilation of Expressions-Compilation of Control Structure-Code Optimization - Interpreters.

**UNIT- V**

**LINKERS:** Relocation and Linking Concepts – Design of a Linker – Self-Relocating Programs – Linking for Overlays - Loader.

**TEXT BOOK**

1. D.M.Dhamdhere, “System Programming And Operating Systems”, New Delhi: Tata McGraw-Hill Publishing Company Limited, 1993.

<b>Unit I</b>	:	Ch.1.1-1.5.
<b>Unit II</b>	:	Ch. 4.1- 4.4 & 5.1-5.3
<b>Unit III</b>	:	Ch.3.1-3.2
<b>Unit IV</b>	:	Ch.6.1-6.6.
<b>Unit V</b>	:	Ch.7.1-7.3 & 7.5 -7.6

**REFERENCE BOOK**

1. John J.Donovan, “Introduction to System Software”, New Delhi, Tata McGraw-Hill Publishing Company Limited, 1993.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>OPERATING SYSTEMS</b>	<b>V</b>	<b>18BCS51C</b>

**Objective:**

- Study the basic concepts and functions of operating systems.
- Understand the structure and functions of OS.
- Learn about Processes, Threads and Scheduling algorithms.
- Understand the principles of concurrency and Deadlocks.
- Learn various memory management schemes.
- Study I/O management and File systems.

**UNIT-I**

**INTRODUCTION:** Abstract view of an operating system - Operating Systems Objectives and Functions – Evolution of Operating Systems - Dual-mode operation - Protecting I/O, memory, CPU, Kernels and micro-kernels – system calls- Structure of Operating System – Components of Computers – various components of operating systems.

**PROCESS DESCRIPTION AND CONTROL:** Job/process concepts - Process Creation – Process Termination - Process states – Process Description – Process Control.

**UNIT-II**

**PROCESS SCHEDULING:** Scheduling basics - CPU-I/O interleaving - (non-)preemption - context switching - Types of Scheduling – Scheduling Criteria – Scheduling Algorithms.

**PROCESS SYNCHRONIZATION AND DEADLOCK:** Concurrent Process – Principles of Concurrency – Race Condition - Mutual Exclusion – Critical section problems – Software support – Hardware Support – Operating System Support – Deadlock: Deadlock Prevention, Avoidance and Detection and recovery.

**UNIT-III**

**MEMORY MANAGEMENT:** Memory hierarchy – Linking and Loading the process – Memory Management requirement - Fixed partitioning - Dynamic partitioning – Buddy Systems – Simple paging – Simple Segmentation – segmentation and paging.

**UNIT-IV**

**VIRTUAL MEMORY MANAGEMENT:** Need for Virtual Memory management – Demand Paging – Copy on write - Page Fault handling – Demand Segmentation – Combined demand segmentation and paging - Thrashing- working set model.

**UNIT-V**

**FILE SYSTEM MANAGEMENT:** Files – Access methods - File System Architecture – Functions of File Management - File Allocation – free space management.

**I/O MANAGEMENT AND DISK SCHEDULING:** Organization of I/O function – Types of I/O devices – Logical Structure of I/O functions – I/O Buffering – Disk I/O – Disk Scheduling algorithms

**TEXT BOOKS**

1. Silberschatz A, Galvin P B and Gagne G, “Operating System Concepts Essentials”, John Wiley & Sons, New York, 2011.
2. William Stallings, “Operating Systems”, Pearson Education, New Delhi, 2009.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>COMPUTER NETWORKS</b>	<b>V</b>	<b>18BCS52C</b>

**Objective :**

- Understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer
- Learn the flow control and Error control

**UNIT – I**

Introduction The Uses of Computer Networks – Networks hardware- Local Area Networks- Metropolitan Area Networks – Wide Area Networks – Wireless Networks - Internetworks – Network software – Design Issues of the layers – Interfaces and services – Connection-oriented and Connectionless services – Reference models – OSI reference model - Layers – Data transmission in OSI Model – The TCP/IP reference Model

**UNIT – II**

The Physical Layer Transmission Media – Magnetic Media – Twisted Pairs – Coaxial cable – Fiber optics –Wireless Transmission – The Electromagnetic Spectrum – Radio transmission – Microwave transmission – Infrared Transmission – Light transmission – The Telephone system – Structure of Telephone system – Modems – Trunks and multiplexing – FDM- TDM – Switching.

**UNIT – III**

The Data Link layer - Data link layer Design Issues – Services provided to Network layer – Framing – Error Control – Flow Control - Error Correcting codes – Error detecting codes - -Elementary Data link protocols- Simplex Protocols- Sliding Window Protocols - Medium Access Control Sub layer - The channel allocation problem – Multiple access protocols - Carrier Sense multiple access protocols, Collision –Free protocols, Limited Contention Protocols.

**UNIT – IV**

The Network Layer – Network Layer Design Issues – Store-and-Forward Packet Switching – Services provided to Transport Layer – Implementation of Connectionless and connection-oriented services - Routing Algorithms -The optimality principle - shortest path Algorithm - Flooding - Distance vector routing – Link state routing – Hierarchical routing – Broadcast routing - Routing for mobile hosts.

**UNIT – V**

Congestion Control Algorithms – Approaches – Traffic-aware Routing – Admission Control – Traffic Throttling – Load shedding - The Transport Layer – Services provided to the upper layers - Transport service primitives – Elements of Transport protocols – addressing – Connection Establishment – Connection Release – Error Control and Flow control – Multiplexing - Crash recovery - Application

Layer – DNS – The Domain Name System – Electronic mail – Architecture and services - the user agent – Message formats – Message Transfer – Final Delivery.

### **TEXT BOOKS**

1. Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks“, 5<sup>th</sup> Edition, Pearson Education Publ. - 2011

### **REFERENCE BOOKS**

1. Miller, ”Data and Network Communications”, Viaks Publ., 2001.
2. William A Shay, “Understanding data communications and Networks”, 2<sup>nd</sup> Edition, Vikas Publ., 2001.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	HTML AND JAVA SCRIPT	V	18BCS53C

**Objective :**

- Create a basic website using HTML and Cascading Style Sheets.
- Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.
- Design rich client presentation using AJAX.
- Design and implement simple web page in PHP, and to present data in XML format.
- Design front end web page and connect to the back end databases

**UNIT I**

**Markup Language (HTML5):** Basics of Html -Syntax and tags of Html- Introduction to HTML5 - Semantic/Structural Elements -HTML5 style Guide and Coding Convention– Html Svg and Canvas – Html API“ s - Audio & Video - Drag/Drop - Local Storage - Web socket API– Debugging and validating Html.

**UNIT II**

**Cascading Style Sheet (CSS3):** The need for CSS – Basic syntax and structure Inline Styles Embedding Style Sheets - Linking External Style Sheets - Introduction to CSS3 – Backgrounds - Manipulating text - Margins and Padding - Positioning using CSS -Responsive Web Design .

**UNIT III**

**Introduction to JavaScript:** - Core JavaScript - Client-Side JavaScript - Lexical Structure : Character Set - Comments - Literals Identifiers and Reserved Words Optional Semicolons types, values, and variables-.**Expressions and Operators.**

**Statements:** Expression Statements - Compound and Empty Statements - Declaration Statements Conditionals - Loops - Jumps -Objects - Creating Objects - Querying and Setting Properties -Deleting Properties -Testing Properties - Enumerating Properties - Object Attributes - - Object Methods Arrays:- Creating Arrays - Reading and Writing Array Elements - -Adding and Deleting Array Elements - Iterating Arrays

**UNIT IV**

**Functions :** Defining Functions -Invoking Functions - Function Arguments and Parameters-Functions As Values - Functions As Namespaces - Closures - Function Properties, Methods, and Constructor - Functional Programming - **Classes and Prototypes** :Classes and Constructors - Java-Style Classes in JavaScript - Augmenting Classes - Classes and Types - Object-Oriented Techniques in JavaScript - Subclasses – Modules-**JavaScript in Web Browsers** : Client-Side JavaScript - Embedding JavaScript in HTML.

**UNIT V**

**Window Object :** Timers - Browser Location and Navigation - Browsing History - Browser and Screen Information - Dialog Boxes.

**Scripting Documents** : Overview of the DOM - Selecting Document Elements - Document Structure and Traversal - Attributes - Element Content - Creating, Inserting, and Deleting Nodes- Generating a Table of Contents.

**Scripting CSS** : Overview of CSS - Important CSS Properties - Scripting Inline Styles - Querying Computed Styles - Scripting CSS Classes - Scripting Stylesheets

**TEXT BOOKS:**

1. Thomas A. Powell, "HTML & CSS: The Complete Reference", Fifth Edition, 2010
2. David Flanagan, "JavaScript: The Definitive Guide, Sixth Edition", O'Reilly Media, 2011

**REFERENCE BOOKS:**

1. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", Fifth Edition, Pearson Education, 2011
2. James Lee, BrentWare , "Open Source Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP" AddisonWesley, Pearson 2009
3. Thomas A Powell, Fritz Schneider, "JavaScript: The Complete Reference", Third Edition, Tata McGraw Hill, 2013
4. Thomas A Powell, "Ajax: The Complete Reference", McGraw Hill, 2008



Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	HTML AND JAVA SCRIPT LAB	V	18BCS54P

**Objective:**

- To provide practical experience in web development using tools like HTML, CSS and JavaScript.

**HTML**

1. Write a HTML program for creation of web site with forms, frames, links, etc.
2. Design a web site using HTML and DHTML. Use basic text formatting and image tags
3. Create a personal website using HTML and DHTML
4. Write a HTML program to display a traditional newspaper with the use of table tags

**CSS 3.0**

1. Implement a CSS programs describing layers, inline, internal and external style sheets
2. Develop a webpage using CSS to set the background color, font, and paragraph
3. Develop a webpage using external CSS to import classes for various HTML tags (Use link and import)
4. Develop a webpage in various styles using CSS

**Java Script**

1. Develop a web page to validate the registration, user login, user profile and payment by credit card pages using JavaScript by importing a .js file
2. Develop a web page to count the number of words and number of vowels in a passage
3. Develop a web page to display a digital clock at the status bar using JavaScript
4. Develop a tool tip text (for form validation) for a web page

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	LINUX SHELL PROGRAMMING LAB	V	18BCS55P

**Objective:**

- To write shell script programs to solve problems.
- To implement some standard Linux utilities such as ls, cp etc. using system calls.

**List of Experiments:**

1. Arithmetic Operations
2. Employee Details
3. Electricity Bill Preparation
4. Sorting
5. Factorial
6. Sum of Numbers
7. Exponent using shell Program
8. Swapping of two numbers
9. Greatest among three numbers
10. Odd or Even
11. Testing the files and directories
12. Expansion and Substitution

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>COMPUTER GRAPHICS</b>	<b>V</b>	<b>18BCS56S</b>

**Objective :**

- Gain knowledge about graphics hardware devices and software used.
- Understand the two dimensional graphics and their transformations.
- Understand the three dimensional graphics and their transformations.
- Appreciate illumination and color models.
- Be familiar with understand clipping techniques.

**UNIT – I**

Overview of Graphics System – Display Devices – CRT – Random Scan and Raster Scan Monitors – Techniques for Producing Color Display – Beam – Penetration and Shadow – Mask Methods – DVST – Plasma – Panel Displays – Hardcopy Devices – Printers and Plotters – Display Processors – Output Primitives – DDA and Bresenham’s line drawing algorithms – Antialiasing lines – Bresenham’s Circle Algorithm – Character Generation.

**UNIT – II**

Two-dimensional Transformations – Scaling, Translation and Rotation – Matrix Representations – Composite Transformations – Reflection – Shearing. Windowing and Clipping – Concepts – Cohen and Sutherland Line Clipping Algorithm – Midpoint Subdivision.

**UNIT – III**

Interactive Input Methods – Keyboard – Light Pens – Tablets – Joysticks – Track ball – Mouse – Picture construction Techniques – Pointing and Positioning – Rubber band methods – Dragging.

**UNIT – IV**

Three-Dimensional Concepts – Display Techniques – Parallel Projection –Perspective Projection – Three-Dimensional Transformations for Scaling, Translation –Rotation, Reflection, Shearing.

**UNIT – V**

Hidden-Surface and Hidden-Line removal – Back face removal – Depth Buffer Method – Scan Line Method – BSP Tree Methods – Depth-Sorting Method – Area-subdivision Method –Octree Methods – Comparison of Hidden-Surface Methods.

**TEXT BOOKS**

1. Donald Hearn and Pauline Baker, Computer Graphics, Prentice Hall of India, 2001.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	OFFICE AUTOMATION	V	18BCS5EL

**Objective:**

- To understand basic computer operations and Operating System
- To become proficient in using: -  
Microsoft Office Packages

**UNIT-I**

**Basics of Computer:** Definition - History & Generation of Computer -Applications of Computer - Advantages of Computer - Characteristics of Computer – Elements of Computer.

**Operating System:** Definition of OS - Functions of OS - Types of OS: Single- user, Multi-User, multi-task, RTOS.

**UNIT-II**

**Introduction to MS-Office: MS-Word** - Working with Documents - Formatting and Aligning of Documents – Setting Page Styles – Creating Tables - Drawing - Mail Merge – Creating letters and Faxes using Ms-Word – printing documents – shortcut keys – paper and printer selection.

**UNIT-III**

**Introduction to MS-Power Point:** introduction to presentation – Creating presentation sheets – formatting a presentation – adding effects to the Presentation-Shortcut keys of PowerPoint.

**UNIT-IV**

**Introduction to MS-Excel:** introduction to spread sheets and its applications – Menus – formula editing – Formatting spread sheets - toolbars and shortcut keys – setting formula – **working with sheets:** Sorting, Filtering, validation, consolidation, subtotal – Creating Charts – Drawing tools – Shortcut keys of Excel.

**UNIT-V**

**Introduction to MS-Access:** Introduction, planning a Database, Starting Access, Access Screen, creating a New Database, Creating Tables, Working with Forms, Creating queries, Finding Information in Databases, Creating Reports, Types of Reports, Printing & Print Preview – Importing data from other databases Viz. Ms-Excel etc – Shortcut Keys of Access.

**TEXT BOOKS:**

- 1) Microsoft Office 2007 Bible - John Walkenbach,Herb Tyson,Faithe Wempen,cary N.Prague,Michael R.groh,Peter G.Aitken, and Lisa a.Bucki -Wiley India pvt.ltd.
- 2) Computer Fundamentals - P. K. Sinha Publisher: BPB Publications

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	VISUAL BASIC PROGRAMMING	VI	18BCS61C

**Objective:**

- Gain knowledge about VB Fundamentals.
- Understand the Branching and Looping
- Understand the VB properties.
- Be familiar with Displaying O/P Data and Designing with the Data Environment Active x Designer.

**UNIT –I**

Introduction - VB Environment – VB Fundamental: Constants, Variables, Data Types, Data Declaration – Operators – Expressions – Library Functions.

**UNIT –II**

Branching and Looping: If...Then, If-Then-Else, Else If, Nested If, Selected-Case, For-Next, Do-Loop, While-Wend, Nested Loops, Stop Statement. VB Controls: Textbox – Checkbox – List Box –Combo Box –Label – Command Button – Directory List –Box –Drive List Box. Assigning Values to Forms and Controls – Naming Controls and Forms – Executing Commands – Displaying O/P Data – Assigning Properties Collectively Using ‘With’ Block

**UNIT –III**

Timer Control, Scroll Bar, Message Box (), Input Box (), Functions, MDI Forms, Menus and Dialog Boxes: Building Drop – Down Menus, Sub Menus - Pop - Up Menus –Dialog Boxes – Debugging And Executing A Projects –Error Handling –Convert –VB Project To Exe File – Procedures – Scope-Optional Arguments.

**UNIT –IV**

Arrays –Parsing Arrays To Procedures- Dynamic Arrays –Array Function –Control Arrays –Data Files –Processing A Data Files –Sequential File –Random Access File.

**UNIT –V**

Database Programming With VB: Understanding Database Management Systems –Understanding Relation Concepts – Using Visual Data Manager- Validating Data – Enter Data –Accessing Fields In Record Sets –SQL – Advanced Data –Bound Controls –Managing Databases. Active Data Objects: Crating Data Project –Designing With The Data Environment Active x Designer –Ado Data Control.

**Text Books :**

1. Byron S. Gottfried, “Visual Basic” Schaum’s Outlines.
2. Gary Cornell, “Visual Basic 6 from the GROUND UP”, TATA McGRAW- HILL EDITION.

**Reference Books:**

1. David Jung , Pierre Boutquin , John D.Conley III , Loren Eidahl , Lowell Mauer , Jack Purdum , “Visual Basic 6 , Super Bible” , Techmedia.
2. Peter Wrights , “ Beginning Visual Basic 6 “ , SPD .
3. Steven Holzner , “Visual Basic 6 Black Book “ , Dreamtech Press , 2000.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	VI	18BCS62C

**Objective:**

- To familiarize Basic Concepts of Artificial Intelligence
- Various steps involved in artificial Intelligence
- Basic Concepts of expert systems

**UNIT – I**

Introduction AI problems – AI techniques–Criteria for success, Problems, Problem Spaces, Search State Space Search – Production Systems – Problem Characteristics – Issues in Design of Search.

**UNIT– II**

Heuristic Search Techniques Generate and Test – Hill Climbing – Best-First, Problem reduction, Constraint Satisfaction, Means – end Analysis.

**UNIT– III**

Knowledge Representation Issues Representations and Mappings – Approaches to Knowledge Representations – Issues in Knowledge Representations – Frame Problem.

**UNIT– IV**

Using Predicate Logic Representing Simple Facts in logic – Representing Instance and Isa relationships – Computable Functions and Predicates – Resolution – Natural Deduction.

**UNIT– V**

Representing Knowledge Using Rules Procedural Vs Declarative Knowledge – Logic Programming – Forward Vs Backward Reasoning – Matching – Control Knowledge - Expert Systems.

**TEXT BOOKS**

1. Elaine Rich and Kevin Knight “Artificial Intelligence” , Tata Mcgraw Hill Publishers Company Pvt. Ltd, Second Edition, 1991.[Chapters(1 –6 only)].

**REFERENCE BOOKS**

1. Artificial Intelligence, George F. Luger, 4<sup>th</sup>Edn., Pearson Edn.,Asia,2002.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	VISUAL BASIC PROGRAMMING LAB	VI	18BCS63P

**Objective:**

- Understand the language Visual Basic to a beginner's level
- Know what objects, methods and properties are and how we work with them
- Be able to code simple Library Management System

**List of Experiments:**

1. Write a VB application for Student Mark List Processing System.
2. Write a VB application to Automate Banking System.
3. Write a VB application for Library Management System.
4. Write a VB application for Inventory Management System.
5. Write a VB application for Gas Agency Billing System.
6. Write a VB application for exercising (B.Sc., Computer Science) UG Admission in Government Arts College, Coimbatore.
7. Write VB coding for Font application.
8. Write a VB program for exercising Notepad application.
9. Write a VB application for processing Payroll using DAO control.
10. Write a VB application for Hospital Management System.
11. Write a VB application for Sales Order Processing (News Paper Vendor) using ADO.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	OPEN SOURCE COMPUTING LAB	VI	18BCS64P

**Objective :**

- To provide practical experience in software development using open source tools like PHP and MySql.

**List of Experiments:**

1. Write a PHP program to validate the Textbox
2. Write a PHP program to draw different shapes
3. Write a PHP program to perform the string manipulation
4. Write a PHP program using MySQL table
5. Write a PHP program to perform user registration form using HTML tags
6. Write a PHP program to display date and time
7. Write a PHP program to check user login
8. Write a PHP program to create a college website
9. Write a PHP program for cookies and session scripts
10. Write a PHP program to perform file read, write, open and append operation.



Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>PROJECT &amp; VIVA VOCE</b>	<b>VI</b>	<b>18BCS65V</b>

### Guidelines for Internal Assessment

**Total Marks: 100**

**1) Title and Abstract submission (10 Marks)**

- The Abstract should have at least 2 Pages.
- No Marks will be given if submitted after due date

**2) Review: 1 (25 Marks)**

\* The Student should submit the following to the Respective Guides during this Review meeting

**1) System Study / Analysis**

- Existing System
- Proposed System
- Feasibility Analysis

**2) System design (Which ever applicable to your Project)**

- Data Flow Diagram
- System Flow Design
- ERD
- Table Design
- Input Design
- Modules Design

**3) Review: 2 (25 Marks)**

\* The Students should submit the following to the respective Guides without fail

**1) System Implementation**

- About the Software used
- Implementation of modules

**4) Review: 3 (25 Marks)**

\* The Students should submit the following to the respective Guides without fail

**1) System Testing**

- Testing Strategies
- Test Plan
- Testing Report of your Software

**5) Rough Project Report Submission for correction (15 Marks)**

**6) Project Report Submission Total Marks 100\***

**\*Note:**

1. 100 Marks will be converted into 20 marks.
2. If the Student fails to attend Review Meeting, respective marks will not be awarded and treated as "Absent".
3. The Student cannot submit project report, if they are absent for all Reviews.

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	<b>OPEN SOURCE COMPUTING</b>	<b>VI</b>	<b>18BCS66S</b>

**Objective :**

To provide knowledge about Open Source Technologies and to help in understanding the programming aspects of Personal Home Page (PHP) and MySQL

**UNIT – I :**

PHP Introduction: History-unique features-basic development concepts. Using variables & operators: storing data in variables-understanding PHP’S data types-using constants-manipulating variables with operators.

**UNIT – II :**

Controlling program flow: if, if-else, if-else if-else, switch case, while, do while, for loop, combining loops, Interrupting and skipping loops, working with string & numeric functions: using string functions, using numeric functions.

**UNIT – III :**

Working with arrays: creating an array – Modifying array element – processing arrays with loops and iterators - using arrays with forms-working with array functions-working with date and time-creating user defined functions.Working with forms: creating a simple Input form –Accessing from- combining HTML and PHP code on single page –using hidden fields to save state –redirecting the user –working with file uploads

**UNIT - IV :**

Creating Classes: Introducing classes and objects-defining and using classes-using advanced OOPs concepts-using constructors and destructors-extending classes-adjusting visibility settings-working with files and directories: reading local file-remote file-specific segments of a file-writing files-processing directories-performing other file and directory operations.

**UNIT – V :**

Reading & Writing Files – Testing File Attributes – Managing Sessions And Using Session Variables – Destroying A Session. Storing Data in Cookies – Selecting Cookies – Removing Cookies Data – Deleting Cookies – Dealing With Date & Time.

**TEXT BOOK :**

1. VikramVaswani, “PHP: A Beginners guide”, Tata McGraw Hill, First edition, 2010.

**REFERENCE BOOK(S):**

1. Matt Doyle, “ Beginning PHP 5.3”, Wiley India pvt. Ltd, First edition, 2010.
2. Steve Suehring, Tim Converse, Joyce Park , “PHP 6 and MySQL 5”, Wiley India pvt. Ltd., First edition, 2010. Anx. UCS (3B.Sc. Computer Science) 2013 Onwards

Year	Subject Title	Sem.	Sub Code
2018 -19 Onwards	E-COMMERCE AND INTERNET SECURITY	VI	18BCS6EL

**Objective:**

- After completing the subject, the students are familiar with E-Commerce, E-Marketing, E-Payment Systems and Data Security

**UNIT-I**

**E-Commerce:** History of E-commerce – Definition of E-Commerce – market models of E-Commerce - Applications of E-Commerce – Architectural of E-Commerce – Advantages and Disadvantages of E-Commerce.

**UNIT-II**

**Technologies of the World Wide Web:** World Wide Web - Internet Client-Server Applications - ISP.  
**E-Marketing:** Traditional Marketing - Online Marketing - E-advertising - E-branding.

**UNIT-III**

**E-Payment Systems:** What are Internet Banking - Digital Payment Requirements - Digital Token-based E-payment Systems - Classification of New Payment Systems - Risks and E-Payment Systems.

**UNIT-IV**

**Data Security:** What is data security – Dimensions of E-security – E-security Requirements – Secure Electronic Transactions – Disposable credit numbers.

**UNIT-V**

**Cyber Security:** Cyber Security - Cyber Attacks – Hacking - SSL - Authentication and assurance of data integrity – Cryptographic based solutions.

**TEXT BOOKS:**

1. E-Commerce “the cutting edge of business” – 2<sup>nd</sup> Edition kamalesh K.Bajaj, Debjani Nag – Tata McGraw HILL. (UNIT: I & IV & V)
2. E- Commerce – An Indian perspective P.T. Joseph. S.J. Fourth edition. PHI 2012. (UNIT – II & III)

**REFERENCE BOOKS:**

1. E-Commerce strategy, technologies and applications David Whitley. Tata McGraw HILL.