Year-2023-2024
Syllabus of B.Sc. Programme: [Subject Name: Computer Science]
In accordance with NEP-2020

Year	Semester	Course Code	Title of Paper	Credits	Max. Marks
1	I	UGCS -101N	Computer Fundamental & PC Software	2	100
		UGCS -101(P)N	Practical Work	2	100
	II	UGCS -102N	C Programming	2	100
		UGCS -102(P)N	Practical Work	2	100
		Skill Enhancement Course			
		SBSCS-02N	Python Programming	4	100
2	III	UGCS -103N	Data Structures	2	100
		UGCS -103(P)N	Practical Work	2	100
		Skill Enhancement Course			
		SBSCS-01N	Discrete Mathematics	4	100
	IV	UGCS -104N	Introduction to Database Management System	2	100
		UGCS -104(P)N	Practical Work	2	100
3	V	**Discipline Centric Elective Course**			
		DCECS -105N	Computer Network	2	100
		DCECS -106N	Operating System	2	100
		DCECS -107(P)N	Practical Work based on 106	2	100
	VI	**Discipline Centric Elective Course**			
		DCECS -108N	C++ and Object Oriented Programming	2	100
		DCECS -109N	Software Engineering	2	100
		DCECS -110(P)N	Practical Work based on 108	2	100
			Total Credit/Max. Marks	**36**	**1600**

Syllabus for [B.Sc.]: Subject: [Computer science]

<table>
<tr><td colspan="3">Course prerequisites: 10+2 with Computer science, Mathematics</td></tr>
<tr><td>Programme: B.Sc.</td><td>Year: 1</td><td>Semester: I</td></tr>
<tr><td colspan="3">Subject: Computer science</td></tr>
<tr><td>Course Code: UGCS -101N</td><td colspan="2">Course Title: Computer Fundamental & PC Software</td></tr>
<tr><td colspan="3">Course Objectives:
• To demonstrate the knowledge of the basic structure, components, features and generations of computers.
• To describe the concept of computer languages, language translators and construct algorithms to solve problems using programming concepts.
• To Compare and contrast features, functioning & types of operating system and computer networks.
• To demonstrate architecture, functioning & services of the Internet and basics ofmultimedia.
• To illustrate the emerging trends and technologies in the field of Information Technology.</td></tr>
<tr><td colspan="3">Course Outcomes:
CO-1 Demonstrate the knowledge of the basic structure, components, features and generations of computers.
CO-2 Describe the concept of computer languages, language translators and construct algorithms to solve problems using programming concepts.
CO-3 Compare and contrast features, functioning & types of operating system and computer networks.
CO-4 Demonstrate architecture, functioning & services of the Internet and basics of multimedia
CO-5 Illustrate the emerging trends and technologies in the field of Information Technology.</td></tr>
<tr><td colspan="2">Credits: 2</td><td>Type of Course: Core</td></tr>
<tr><td colspan="2">Max. Marks: 100</td><td>Min. Passing Marks: 36</td></tr>
<tr><td>Block 1</td><td colspan="2"></td></tr>
<tr><td>Unit I</td><td colspan="2">Computer Basics:
Algorithms, A Simple Model of a Computer, Characteristics of Computers, Problem-solving Using Computers.
Data Representation: Representation of Characters in computers, Representation of Integers, Representation of Fractions, Hexadecimal Representation of Numbers, Decimal to Binary Conversion, Error-detecting codes. Input & Output Devices: Description of Computer Input Units, Other Input Methods, Computer Output Units (Printers, Plotters) Operating Systems: History and Evolution. Main functions of OS Multitasking, Multiprocessing. Time Sharing, Real Time OS with Examples Database Management System: Purpose and Organization of Database, Introduction to Data Models.</td></tr>
<tr><td>Unit II</td><td colspan="2">Disk operating system(DOS):
Introduction, history & versions of DOS, DOS basics- Physical structure of disk, drive name, FAT, file & directory structure and naming rules, booting process, DOS system files, DOS commands- internal & external,.</td></tr>
<tr><td>Unit III</td><td colspan="2">Windows Operating System:
Windows concepts. Features, Windows Structure, Desktop, Taskbar, Start Menu, My Computer, Recycle Bin, Windows Accessories- Calculator, Notepad, Paint, Wordpad, Character Map, Windows Explorer, Entertainment, Managing Hardware & Software- Installation of Hardware & Software, Using Scanner, System Tools, Communication, Sharing Information between programs</td></tr>
<tr><td>Block 2</td><td colspan="2"></td></tr>
<tr><td>Unit IV</td><td colspan="2">Word Processing- MS-Word
Features, Creating, Saving and Opening Documents in Word, Interface, Toolbars, Ruler, Menus, Keyboard Shortcut, Editing, Previewing, Printing,& Formatting a Document,</td></tr>
</table>

	Advanced Features of MS Word, Find & Replace, Using Thesaurus, Using Auto-Multiple Functions, Mail Merge, Handling Graphics, Tables & Charts, Converting a word document into various formats like- Text, Rich. Text format, Word perfect, HTML etc.
Unit V	**Worksheet- MS-Excel:** Worksheet basics, creating worksheet, entering into worksheet, heading information, data, text, dates, alphanumeric values, saving & quitting worksheet, Opening and moving around in an existing worksheet, Toolbars and Menus, Keyboard shortcuts, Working with single and multiple workbook, working with formulae & cell referencing, Auto sum, Coping formulae, Absolute & relative addressing, Worksheet with ranges, formatting of worksheet, Previewing & Printing worksheet, Graphs and charts. Database, Creating and Using macros, multiple worksheets- concepts, creating and using.

Suggested Text Book Readings:

1. Fundamental of Computers – By V.Rajaraman, B.P.B. Publications
2. Fundamental of Computers – By P.K. Sinha
3. Microsoft Office 2007 Bible – John Walkenbach, HerbTyson, Faithe Wempen, caryN. Prague, Michael R.groh, PeterG. Aitken, and Lisa a. Bucki -Wiley India pvt. ltd
4. Discovering the Internet: Complete - Shelly Cashman 4th Edition - Course Technology

Reference Books:

1. Introduction to Information Technology - Alexis Leon, Mathews Leon, and Leena Leon, Vijay Nicole Imprints Pvt. Ltd., 2013.
2. Office 2007 – By Shelly, Cengage Publication

Suggested online links: https://www.pearsoned.co.in/prc/book/anita-goel-computer-fundamentals-1e-1/9788131733097

Electronic media and other digital components in the curriculum:	
Name of electronic media: e-SLM	Year of incorporation: 2020

Syllabus for [B.Sc.]: Subject: [Computer science]

<table>
<tr><td colspan="3">Course prerequisites: 10+2 with Computer science, Mathematics</td></tr>
<tr><td>Programme: B.Sc.</td><td>Year: 1</td><td>Semester: 1</td></tr>
<tr><td colspan="3">Subject: Computer science</td></tr>
<tr><td>Course Code: UGCs 101P(N)</td><td colspan="2">Course Title: Practical -WORK</td></tr>
<tr><td colspan="3">Course Objectives:
• To understand the fundamental concept of computer.
• To understand the basics concept of communication and network.
• To explore various features of MS-Word and its applications.
• To develop understanding of MS-Excel. To design the presentation using MS-power Point. To understand the fundamental concept of database and working with MS-Access</td></tr>
<tr><td colspan="3">Course Outcomes:
CO1. Understand the basic component of computers, software and Hardware.
CO2. Acquire knowledge about MS-Word and different formatting styles used in that.
CO3. Acquire knowledge about MS-Excel and different techniques used in that.
CO4. Acquire knowledge about MS-Power Point and formatting styles used in that.
CO5. Acquire knowledge about MS-Access and different techniques such as creating form, writing queries used in that.</td></tr>
<tr><td colspan="2">Credits: 2</td><td>Type of Course: Core</td></tr>
<tr><td>Max. Marks: 100</td><td colspan="2">Min. Passing Marks: 36</td></tr>
<tr><td colspan="3">Suggestive Practical List</td></tr>
<tr><td colspan="3">• Learn and Understand the basic component of computers, software and Hardware.
• Do practice on MS-Word and different formatting styles used in that.
• Do practice onMS-Excel and different techniques used in that.
• Do practice on MS-Power Point and formatting styles used in that.
• Do practice and Acquire knowledge about MS-Access and different techniques such as creating form, writing queries used in that.</td></tr>
<tr><td colspan="3">Suggested Text Book Readings:
1. Fundamental of Computers – By V.Rajaraman, B.P.B. Publications
2. Fundamental of Computers – By P.K. Sinha
3. Microsoft Office 2007 Bible – John Walkenbach, HerbTyson, FaitheWempen, caryN.Prague, MichaelR.groh, PeterG.Aitken, and Lisa a.Bucki -Wiley India pvt.ltd
4. Discovering the Internet: Complete - Shelly Cashman 4th Edition - Course Technology
Reference Books:
1. Introduction to Information Technology - Alexis Leon, Mathews Leon, and Leena Leon, Vijay Nicole Imprints Pvt. Ltd., 2013.
2. Office 2007 – By Shelly, Cengage Publication</td></tr>
<tr><td colspan="3">Electronic media and other digital components in the curriculum:</td></tr>
<tr><td colspan="2">Name of electronic media: e-SLM</td><td>Year of incorporation: 2021</td></tr>
</table>

Syllabus for [B.Sc.]: Subject: [Computer science]

Course prerequisites: 10+2 with Computer science, Mathematics		
Programme:B.Sc.	Year:1	Semester:2
Subject: **Computer science**		
Course Code: UGCS-102N	Course Title: **C Programming**	
Course Objectives: • To describe & understand the problem solving techniques. • To understand the concept of basic terminology used in C programming. • To develop programs in C language by writing, compiling and debugging. • To develop programs involving simple statements, conditional statements, iterative statements, array, strings, functions, recursion, structure and union. • To differentiate between call by value and call by reference, acquire skills of using dynamic memory allocations, use of pointers and basic operations on a file..		
Course Outcomes: CO1. Describe the functional components and fundamental concepts of a digital computer system including number systems. CO2. Construct flowchart and write algorithms for solving basic problem CO3. Write 'C' programs that incorporate use of variables, operators and expressions along with data types. CO4. Write simple programs using the basic elements like control statements, functions, arrays and strings. CO5. Write advanced programs using the concepts of pointers, structures, unions and enumerated data types.		
Credits: 2		**Type of Course:** Core
Max. Marks: 100	Min. Passing Marks: 36	
Block 1	**Introduction to algorithms and program design**	
Unit I	**Unit 1: Introduction to Algorithms** Problem solving techniques, Algorithm	
Unit II	**Pseudo-codes and Flowcharts** Tools of Algorithm, Pseudo codes, Flowchart	
Unit III	**Program design principles** Introduction to computer programming, Program design principles, Programming techniques, Program Errors	
Block 2	**Introduction to the 'C' programming language**	
Unit 1	**Unit 1: Introduction** History of C Language, Structure of a 'C' program, Creating and Executing a 'C' program	
Unit 2	**Data Types in 'C'** Character Set of 'C' language, Tri graph characters, Tokens, Identifiers, Keywords, Constants, Data types, Variables	
Unit 3	**Storage Classes** Scope and lifetime of variable, Storage classes, Automatic storage class, Register storage class, Static storage class, External storage class	
Unit 4	**Input and Output Functions** Reading a single character, Writing a single character, Formatted Input-Output, Formatted Input, Formatted Output	
Block 3:	**Operator and Control Structures**	
Unit 1:	**Operators and Expressions** Arithmetic operators, Relational operators, Logical operators, Assignment operators,	

	Increment and decrement operators, Conditional operators, Bitwise operators, Special operators, Operator Precedence and Associativity, lvalue and rvalue, Type casting: Promotion and Demotion of variable types
Unit 2:	**Decision Structures in 'C'** if statement, if else statement, nested if … else statement, switch statement, goto statment
Unit 3:	**Loop Structures in 'C'** for statement, while statement, do while statement, break statement, continue statement
Unit 4:	**Arrays** One dimensional array, Two dimensional array, Multidimensional arrays, Strings, String handling functions, Character functions
Block 4	**Advanced Features of C**
Unit 1:	**Pointers** Pointers and Address (&) operator, Pointer declaration and Initialization , Indirection operator, Pointer Arithmetic, Arrays and Pointers, Character strings and Pointers, Array of Pointers, Pointer to Pointer
Unit 2:	**Functions** Functions, user-defined functions, categories of function, returning non-integer values, function arguments, recursion, arrays as function arguments
Unit 3:	**Structures, Unions, enum and typedef** Structure definition, Structures within structures, Structures as function arguments, Pointers to structures, Unions, Enumerated data type, Type definition
Unit 4:	**File and Memory Management in 'C'** Files, File Pointer Variable, Opening a file, Reading and writing to files, File Status Functions, Random Access to files, Command Line Arguments, Memory management
Unit 5:	**Preprocessor Directives and Error reporting** Macro directives, Conditional directives, Control directives, Error reporting

Suggested Readings:

SLM of University

1. Kanetkar Y., "Let Us C", BPB Publications.
2. E. Balagurusamy, Computer Concepts and Programming in C, McGraw Hill.
3. Yashwant Kanetkar, "Working with C", BPB Publications.
4. E. Balagurusamy, "Programming in ANSI C", TMH.
5. Reema Thareja, Computer Fundamentals and Programming in C, Oxford Publication.
6. Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, Pearson Education.
7. Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Computer Science- A Structured Programming Approach Using C, Cengage Learning.
8. Schildt H., "C- The Complete Reference", McGraw-Hill.
9. Goyal K. K. and Pandey H.M., Trouble Free C", University Science Press
10. Gottfried B., "Schaum's Outlines- Programming in C", McGraw-Hill Publications.

Electronic media and other digital components in the curriculum:	
Name of electronic media: e-SLM	Year of incorporation: 2021

Syllabus for [B.Sc.]: Subject: [Computer science]

Course prerequisites: 10+2 with Computer science, Mathematics		
Programme: B.Sc.	Year:1	Semester:2
Subject: **Computer science**		
Course Code: **UGCS 102P (N)**	Course Title: Practical Work Based on UGCS 102	

Course Objectives:

1. To write, compile, debug and execute programs in a C programming environment.
2. To learn programs that incorporate use of variables, operators and expressions along with data types.
3. To learn programs for solving problems involving use of decision control structures and loops.
4. To learn programs that involve the use of arrays, structures and user defined functions.
5. To Write programs using file handling operations.

Course Outcomes:

CO1. Write, compile, debug and execute programs in a C programming environment.

Credits:2	**Type of Course:** Core
Max. Marks: 100	Min. Passing Marks: 36

Suggestive List of Practical

- Program to implement conditional statements in C language.
- Program to implement switch-case statement in C language
- Program to implement looping constructs inC language.
- Program to perform basic input-output operations in C language.
- Program to implement user defined functions in C language.
- Program to implement recursive functions in C language.
- Program to implement one-dimensional arrays in C language.
- Program to implement two-dimensional arrays in C language.
- Program to perform various operations on two-dimensional arrays in C language.
- Program to implement multi-dimensional arrays in C language.
- Program to implement string manipulation functions in C language.
- Program to implement structure in C language.
- Program to implement union in C language.
- Program to perform file handling operations in C language.

Suggested Text Book Readings:

SLM of University

1. Kanetkar Y., "Let Us C", BPB Publications.
2. E. Balagurusamy, Computer Concepts and Programming in C, McGraw Hill.
3. Yashwant Kanetkar, "Working with C", BPB Publications.
4. E. Balagurusamy, "Programming in ANSI C", TMH.
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6. Jeri R. Hanly, Elliot B. Koffman, Problem Solving and Program Design in C, Pearson Education.
7. Behrouz A. Forouzan, Richard F. Gilberg, Thomson, Computer Science- A Structured Programming Approach Using C, Cengage Learning.
8. Schildt H., "C- The Complete Reference", McGraw-Hill.
9. Goyal K. K. and Pandey H.M., Trouble Free C", University Science Press
10. Gottfried B., "Schaum's Outlines- Programming in C", McGraw-Hill Publications.

Electronic media and other digital components in the curriculum:

Name of electronic media: e-SLM	Year of incorporation: 2021

Syllabus for [B.Sc.]: Subject: [Computer science]

Course prerequisites: 10+2 with Computer science, Mathematics		
Programme: B.Sc.	Year: 1	Semester: 2
Subject: **Computer science**		
Course Code: SBSCS-02N	Course Title: Python Programming	
Course Objectives: 1. To acquire programming skills in core Python. 2. To explore the use of data structures, strings, text files, lists and dictionaries. 3. To acquire Object Oriented Skills in Python. 4. To understand to solve the problems with Python database, Python multithreading. 5. To work with Django framework, Numpy and other libraries.		
Course Outcomes: CO1. Understand and comprehend the Basics of Python programming. CO2. Describe and explain the use of the built-in data structures list, sets, tuples and dictionary. CO3. Make use of functions, modules and its applications. CO4. Demonstrate the principles of OOPs and identify real-world applications using OOPs, files and exception handling provided by Python.		
Credits: 4		**Type of Course:** Core
Category of Course		Value-added / employability/
Max. Marks: 100	Min. Passing Marks: 36	

Block 1	**BASICS OF PYTHON**
Unit I	**UNIT – 1: Introduction:** History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Python IDLE.
Unit II	**Tokens and Statements**: Variables, Constants, Assignment, Multiple Assignment, Keywords, Punctuators, Identifiers, Input-Output, Indentation, Statements, Comments, Single Comment and Multiline Comment.
Unit III	**Data Types, Operators & Expressions:** Types – Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Operators precedence, Expressions and order of evaluations Control Flow- if, if-else, if-elif-else, for, while, break, continue, pass.
Block 2	**DATA STRUCTURE IN PYTHON**
Unit IV	**Data Structures:** Stack & Queue, Lists – Operations, Slicing, Methods; Tuples – Operations, Methods , Sets– Operations , Methods, Dictionaries– Operations , Methods, Sequences– Operations, Methods. Comprehensions– Operations , Methods.
Unit V	**Functions –** Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables
Unit VI	**Modules &Packages**: Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages.
BLOCK 3	**OOPS IN PYTHON**
Unit VII	**UNIT – 7: Object-Oriented Programming OOP in Python**: Classes, ' self-variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding.
Unit VIII	**UNIT – 8: Exception Handling :**Error, and Exceptions: Difference between an error and

	Exception, Handling Exception, try except for block, Raising Exceptions, User Defined Exceptions
Unit IX	**UNIT – 9: Python Libraries:** Brief Tour of the Standard Library – Operating System Interface – String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression
Unit X	**UNIT – 10: GUI Programming and Testing** : Multithreading, GUI Programming, Turtle Graphics Testing: Why testing is required ?, Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.
BLOCK 4:	**MACHINE LEARNING IN PYTHON**
Unit XI	**UNIT – 11: Machine Learning Using Python :**Machine Learning Basics, Features and Labels, Supervised and Unsupervised Learning.
Unit XII	**UNIT – 12: Regression and Classification in Machine Learning:** Simple Linear Regression, Multiple Regression, Data Collection for Machine Learning, Classification – Features and Types

Suggested Text Book Readings:

1. Kenneth A. Lambert, Martin, Juneja "Fundamentals of Python", Cengage Learning.
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.
3. Learning Python, Mark Lutz, Orielly.
4. Harsh Bhasin, “Python for Beginners”, New Age International.
5. Ashok Namdev Kamthane , Programming and Problem Solving with Python, TMH.
6. Allen Downey, Learning with Python, Dreamtech.

Suggestive digital platforms web links-

http://docs.python.org/3/tutorial/index.html
http://interactivepython.org/courselib/static/pythonds
http://www.ibiblio.org/g2swap/byteofpython/read/

Electronic media and other digital components in the curriculum:

Name of electronic media: e-SLM	Year of incorporation: 2021

Syllabus for [B.Sc.]: Subject: [Computer science]

<table>
<tr><td colspan="3">Course prerequisites: 10+2 with Computer science, Mathematics</td></tr>
<tr><td>Programme: B.Sc.</td><td>Year:2</td><td>Semester:3</td></tr>
<tr><td colspan="3">Subject: Computer science</td></tr>
<tr><td>Course Code: UGCS -103N</td><td colspan="2">Course Title: Data Structures</td></tr>
<tr><td colspan="3">Course Objectives:
1. To develop the understanding of data structures, their types and applications.
2. To familiarize with concepts of algorithm and complexity.
3. To implement, analyze various data-structures as array, linked-list, stack, queue, tree, graph, etc. in detail and utilization of data structure techniques in problem solving.
4. To develop the understanding of various sorting and searching techniques.</td></tr>
<tr><td colspan="3">Course Outcomes:
CO1. Explain the concept of data structure, abstract data types, algorithms and analysis of algorithms.
CO2. Describe basic data organization schemes such as arrays and linked lists, implementation of linked lists, operations on linked-list,
CO3. Describe stacks and queues, their applications and implement various operations on them using arrays and linked lists
CO4. Describe the properties of trees and graphs and implement various operations such as searching and traversal on them</td></tr>
<tr><td colspan="2">Credits: 2</td><td>Type of Course: Core</td></tr>
<tr><td colspan="2">Category of Course</td><td>Value-added / employability/</td></tr>
<tr><td>Max. Marks: 100</td><td colspan="2">Min. Passing Marks: 36</td></tr>
<tr><td>Block 1</td><td colspan="2"></td></tr>
<tr><td>Unit I</td><td colspan="2">UNIT 1: Introduction to data structure
Algorithm, Basic criteria for algorithms, Data type, Data structure, Data representation, linear and non linear data structure.</td></tr>
<tr><td>Unit II</td><td colspan="2">UNIT 2: Basics of algorithm
Algorithm, Basics of complexity of algorithm</td></tr>
<tr><td>Unit III</td><td colspan="2">UNIT 3:Array
Definition, Representation of array, Single and multi-dimensional array, address calculation (one dimensional, two dimensional, multidimensional), sparse matrices</td></tr>
<tr><td>Block 2</td><td colspan="2"></td></tr>
<tr><td>Unit IV</td><td colspan="2">UNIT 4: Stack
Definition, Operations on stacks, Array representation and implementation of stadk; infix, prefix and postfix representation of expression and evaluation multiple stacks, Application of stacks.</td></tr>
<tr><td>Unit V</td><td colspan="2">UNIT 5: Recursion
Recursive definition and processes, some named problems of recursion, principle of recursion: designing recursive algorithm, how recursion works, tail recursion.</td></tr>
<tr><td>Unit VI</td><td colspan="2">UNIT 6: Queue
Definition, operation on queues, circular queue, dequeue, priority queue, Application of queue.</td></tr>
<tr><td>BLOCK 3</td><td colspan="2"></td></tr>
<tr><td>Unit VII</td><td colspan="2">UNIT 7: Linked List
Representation and implementation of single linked list, Operations in the singly linked list, stack and queue as a linked list, circularly linked list, doubly linked list, circularly doubly linked list, Application of linked list: polynomial representation and addition, garbage collection</td></tr>
<tr><td>Unit VIII</td><td colspan="2">UNIT 8: Tree</td></tr>
</table>

	Basic terminology, binary tree, binary tree representation, complete binary tree, extended binary tree, array and linked list representations, traversing binary tree, threaded binary tree, binary search tree, Operations on BST, AVL tree, Operations on AVL tree, B-tree Insertion and deletion in B tree.
Unit IX	**UNIT 9: Graph** Basic terminology Graph representation Depth first search, breadth first search, topological sort, connected components, spanning tree, minimum cost spanning tree, Kruskal's and prim's algorithm, Shortest path algorithms: Bellman Ford Algorithm, Dijkstra's algorithm, Floyd-Warshall algorithm.
BLOCK - 4	
Unit X	**UNIT 10: Searching and sorting** Sequential search, binary search, comparison and analysis, Selection sort, Bubble sort, Insertion sort, Heap sort, Quick Sort, Merge sort, Shell sort, radix sort.
Unit XI	**UNIT 11: Hashing** Hash table, hash function, collision resolution strategies, hash table implementation
Unit XII	**UNIT 12: File Structure** Terminology, File organization, Sequential files, Direct File organization, Indexed Sequential file organization

Suggested Text Book Readings:

1. Y. Langsam, M. Augenstin and A. Tannenbaum, Data Structures using C and C++, Pearson Education Asia.
2. Ellis Horowitz, S. Sahni, D. Mehta Fundamentals of Data Structures in C++, Galgotia Book Source, New Delhi.
3. S. Lipschutz, Data Structures Mc-Graw Hill International.
4. Data Structures: A Pseudocode Approach with C, Second Edition, Richard F. Gilberg, Behrouz A. Forouzan
5. Jean-Paul Tremblay, Paul. G. Soresan, An introduction to Data Structures with Applications, Tata Mc-Graw Hill International Edition.
6. A. Michael Berman, Data structures via C++, Oxford University Press.
7. Thomas H. Cormen, Introduction to Algorithms, 3rd Edition (The MIT Press).
8. M. Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education.
9. Tremblay & Sorenson, An Introduction to Data Structures with Applications, Mcgraw Hill.
10. R.S. Salaria, Data Structures and Applications using C, Khanna Book Publishing.
11. Samanta D., "Classic Data Structures", Prentice Hall India.
12. Aho, Ullman and Hopcroft, "Design and Analysis of algorithms", Pearson Education.
13. R. Neapolitan and K. Naimipour, "Foundations of Algorithms", Jones an Bartlett, Student edition.
14. Reema Thareja, Data Structures using C, Oxford Univ. Press

Suggestive digital platforms web links or online course-

https://www.oercommons.org/authoring/14873-data-structure/view
https://www.oercommons.org/courses/data-structure-and-algorithms
https://onlinecourses.swayam2.ac.in/cec19_cs04/preview **(online course)**

Electronic media and other digital components in the curriculum:

Choose any one or more than: e-SLM/ Other electronic and digital contents

Name of electronic media: e-SLM	Year of incorporation: 2021

Syllabus for [B.Sc.]: Subject: [Computer science]

<table>
<tr><td colspan="3">Course prerequisites: 10+2 with Computer science, Mathematics</td></tr>
<tr><td>Programme: B.Sc.</td><td>Year: 2</td><td>Semester: 3rd</td></tr>
<tr><td colspan="3">Subject: Computer science</td></tr>
<tr><td>Course Code: UGCS -103(P)N</td><td colspan="2">Course Title: Practical Work Based on UGCS 103</td></tr>
<tr><td colspan="3">Course Objectives:
• To learn implementation of various Data Structures.
• To applying data structures in solving real life problems using C/Python.
• To learn implementation of various Data Structures.</td></tr>
<tr><td colspan="3">Course Outcomes:
CO1. Write and execute programs to implement different searching algorithms.
CO2. Write and execute programs to implement various sorting algorithms
CO3. Write and execute programs to implement various operations on two-dimensional arrays..
CO4. Implement various operations of Stacks and Queues using both arrays and linked lists data structures.
CO5. Implement graph algorithm to solve the problem of spanning tree</td></tr>
<tr><td colspan="2">Credits: 2</td><td>Type of Course: Core</td></tr>
<tr><td colspan="2">Category of Course</td><td>value-added / employability/</td></tr>
<tr><td>Max. Marks: 100</td><td colspan="2">Min. Passing Marks: 36</td></tr>
<tr><td colspan="3">(Practical Work Based on UGCS 103)</td></tr>
<tr><td colspan="3">• To implement addition and multiplication of two 2D arrays.
• To transpose a 2D array.
• To implement stack using array
• To implement queue using array.
• To implement circular queue using array.
• To implement stack using linked list.
• To implement queue using linked list.
• To implement BFS using linked list.
• To implement DFS using linked list.
• To implement Linear Search.
• To implement Binary Search.
• To implement Bubble Sorting.
• To implement Selection Sorting.
• To implement Insertion Sorting.
• To implement Merge Sorting.
• To implement Heap Sorting.
• To implement Matrix Multiplication by Strassen’s algorithm
• Find Minimum Spanning Tree using Kruskal’s Algorithm</td></tr>
<tr><td colspan="3">Electronic media and other digital components in the curriculum:</td></tr>
<tr><td colspan="2">Name of electronic media: e-SLM</td><td>Year of incorporation: 2021</td></tr>
</table>

Syllabus for [B.Sc.]: Subject: [Computer science]

<table>
<tr><td colspan="3">Course prerequisites: 10+2 with Computer science, Mathematics</td></tr>
<tr><td>Programme: B.Sc.</td><td>Year:2</td><td>Semester:3</td></tr>
<tr><td colspan="3">Subject: Computer science</td></tr>
<tr><td>Course Code: SBSCS-01N</td><td colspan="2">Course Title: Discrete Mathematics</td></tr>
<tr><td colspan="3">Course Objectives:
• To perform operations on discrete structures such as sets, functions, relations.
• To apply mathematical arguments using logical connectives and quantifiers.
• To identify and prove properties of Algebraic Structures.
• To formulate and solve recurrences and recursive functions.
• To apply the concept of combinatorics to solve basic problems in discrete mathematics.</td></tr>
<tr><td colspan="3">Course Outcomes:
CO1. Use mathematical and logical notation to define and formally reason about basic discrete structures such as Sets, Relations and Function
CO2. Apply mathematical arguments using logical connectives and quantifiers to check the validity of an argument through truth tables and propositional and predicate logic
CO3. Identify and prove properties of Algebraic Structures like Groups, Rings and Fields
CO4. Formulate and solve recurrences and recursive functions
CO5. Apply the concept of combinatorics to solve basic problems in discrete mathematics</td></tr>
<tr><td colspan="2">Credits: 4</td><td>Type of Course: Core</td></tr>
<tr><td colspan="2">Category of Course</td><td>Skill development</td></tr>
<tr><td>Max. Marks: 100</td><td colspan="2">Min. Passing Marks: 36</td></tr>
<tr><td>Block 1</td><td colspan="2">Language of Mathematics and its application</td></tr>
<tr><td>Unit I</td><td colspan="2">Mathematical Logic: statements, operations, truth values, tautology and quantifiers.</td></tr>
<tr><td>Unit II</td><td colspan="2">Arguments: Rule of Detachment, Validity of a compound statement by using Truth Table , Validity using Simplification Methods, Validity using Rules of Inference, Invalidity of an Argument, Indirect Method of proof and Proof by Counter-Example.</td></tr>
<tr><td>Unit III</td><td colspan="2">Boolean Algebra: Boolean Algbera, Principle of Duality, Isomorphic Boolean Algebras, Boolean Algebra as Lattices, Boolean Functions, Disjunctive Normal Form, Conjunctive Normal Form, Minimization of Boolean Functions (Karnaugh Map)</td></tr>
<tr><td></td><td colspan="2">Switching circuits and logical Circuits : Switching Circuits, Simplification of circuit, Non-Series Parallel Circuits, Relay Circuits, Logic Circuits</td></tr>
<tr><td>Block 2</td><td colspan="2">Set theory and its application</td></tr>
<tr><td>Unit I</td><td colspan="2">Set theory: sets, Subsets, Operations on Sets, Complementation, Intersection and Union, Laws Relating Operations, Distributive Laws and De Morgan’s Laws</td></tr>
<tr><td>Unit II</td><td colspan="2">Relation: Relation, binary relations in a Set, Domain and Range of a Relation, Total number of Distinct Relations, Relations as Sets of Ordered Pairs, Types of Relations, Composition of Relations, Equivalence relation in a set, Partition of a Set, Equivalence Class and Quotient set of a set.</td></tr>
<tr><td>Unit III</td><td colspan="2">Partitions and Distributions: Equivalence Relations, Equivalence Classes, Properties of Equivalence Classes, Quotient set and Partition.</td></tr>
<tr><td>Unit IV</td><td colspan="2">Function: Functions, Direct and Inverse image, Inverse Functions, Operations on Functions, Composite of functions, Types of Functions and Connection between Equivalence relation and mapping.</td></tr>
<tr><td>Block – 03</td><td colspan="2">Counting Process</td></tr>
</table>

Unit I	**Mathematical Induction:** Principle of Mathematical Induction, Second Principle of Induction and Well ordering property.
Unit II	**Combinatorics:** Basic counting principles**,** Principle of Disjunctive counting, Principle of Sequential counting and Ordered and Unordered Partitions.
Unit III	**Permutation**
Unit IV	**Combination**
Block – 04	**Probability theory and application**
Unit I	**Binomial theorem:** Binomial theorem, General term in a binomial expansion, Middle term in a binomial expansion and Binomial expansion for rational exponents
Unit II	**Probability:** Definition of Probability, Addition law for counting and Product law for counting.
Unit III	**General Counting methods:** General Counting method is the extension part of counting process. It discusses Sum and Product Rulesand The Pigeonhole Principle **.**
Unit IV	**The Inclusion- Exclusion Principle:** inclusion-exclusion principle, Alternative form of the inclusion-exclusion principle and Onto Functions.

Suggested Text Book Readings:

Suggested online links:

1. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", McGraw Hill.
2. B. Kolman, R.C Busby and S.C Ross, "Discrete Mathematics Structures", Prentice Hall.
3. R.P Girimaldi, "Discrete and Combinatorial Mathematics", Addison Wesley.
4. Y.N. Singh, "Discrete Mathematical Structures", Wiley- India.
5. Swapankumar Sarkar, "A Textbook of Discrete Mathematics", S. Chand & Company PVT. LTD.V.
6. Krishnamurthy, "Combinatorics Theory & Application", East-West Press Pvt. Ltd., New Delhi.
7. Liptschutz, Seymour, "Discrete Mathematics", McGraw Hill.
8. J.P. Trembely&R.Manohar, "Discrete Mathematical Structure with application to Computer Science", McGraw Hill.

Electronic media and other digital components in the curriculum:

Choose any one or more than: e-SLM/ Other electronic and digital contents

Name of electronic media: e-SLM	Year of incorporation: 2021

Syllabus for [B.Sc.]: Subject: [Computer science]

<table>
<tr><td colspan="4">Course prerequisites: 10+2 with Computer science, Mathematics</td></tr>
<tr><td colspan="2">Programme: B.Sc.</td><td>Year: 2</td><td>Semester:4th</td></tr>
<tr><td colspan="4">Subject: Computer science</td></tr>
<tr><td colspan="2">Course Code: UGCS -104N</td><td colspan="2">Course Title: Introduction to Database Management System)</td></tr>
<tr><td colspan="4">Course Objectives:
• To learn the features of a database system and its application and compare various types of data models.
• To construct an ER Model for a given problem and transform it into a relation database schema.
• To formulate solution to a query problem using SQL Commands, relational algebra, tuple calculus and domain calculus.
• To understand the need of normalization and normalize a given relation to the desired normal form.
• To understand different approaches of transaction processing and concurrency control.</td></tr>
<tr><td colspan="4">Course Outcomes:
CO1. Describe the features of a database system and its application and compare various types of data models.
CO2. Construct an ER Model for a given problem and transform it into a relation database schema.
CO3. Formulate solution to a query problem using SQL Commands, relational algebra, tuple calculus and domain calculus.
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CO5. Explain different approaches of transaction processing and concurrency control.</td></tr>
<tr><td colspan="2">Credits: 2</td><td colspan="2">Type of Course: Core</td></tr>
<tr><td colspan="2">Category of Course</td><td colspan="2">employability/ skill development/</td></tr>
<tr><td colspan="2">Max. Marks: 100</td><td colspan="2">Min. Passing Marks: 36</td></tr>
<tr><td>Block 1</td><td colspan="3"></td></tr>
<tr><td>Unit I</td><td colspan="3">UNIT 1: Overview of database management
Introduction, Traditional oriented approach, Three view of data, The three level architecture of DBMS, DDL, DML, data model schemas and instances, Advantage and disadvantage of database management system.</td></tr>
<tr><td>Unit II</td><td colspan="3">UNIT 2: Database Models and implementation
Introduction, file management system, entity relationship model, the hierarchical model, network model. the relational model</td></tr>
<tr><td>Unit III</td><td colspan="3">. UNIT 3: Entity relationship model
ER model concept, notations of ER diagram, mapping constraints, keys, concept of super key, candidate key, primary key, verbalization, aggregation reduction oF ER diagram to tables, extended ER model, relationship of higher degree</td></tr>
<tr><td>Block 2</td><td colspan="3"></td></tr>
<tr><td>Unit IV</td><td colspan="3">UNIT 4: Relational Model
Concept, Formal definition of a relation, entirety. constraint, entity indignity, referential integrity, keys constraints, domain constraint, relational algebra relational calculus.</td></tr>
<tr><td>Unit V</td><td colspan="3">UNIT 5: SQL
Characteristic of SQL, Advantage of SQL, SQL data types, SQL commands, SQL operators, insertion, update and delete operations, joins, unions intersection, minus, views, queries and sub queries, aggregate function, cursor in SQL</td></tr>
<tr><td>Unit VI</td><td colspan="3">UNIT 6: Database Design</td></tr>
</table>

	Conceptual, logical and physical design, Functional dependencies, normal form, first, second, third, BCNF, multi-valued dependencies, fourth normal form, join dependencies, fifth normal form, inclusion dependencies, lossless join decomposition, normalization using FD, MVD and JDs.
BLOCK - 3	
	UNIT 7: File Organization Introduction, file organization, sequential file organization, index-sequential file organization, direct file organization, multi key file organization.
	UNIT 8: Transaction Processing Concept Transaction system, testing of serializability, serializability of schedules, conflict and view serializable schedule, recoverability, recovery from transaction failure, Joe based recovery, checkpoints, deadlock handling, concept of concurrency.

Suggested Text Book Readings:

1. Date, C.J.,"An Introduction to Database Systems", Narosa Publishing House, New Delhi.
2. Korth, Silbertz, Sudarshan, “Database Concepts”, Tata Mcgraw-hill Education (India).
3. Elmasri, Navathe, “Fundamentals Of Database Systems”, Pearson Education New Delhi India.
4. G.K. Gupta, “Database Management System”, Tata Mcgraw-hill Education (India) Pvt. Ltd.
5. Bipin C. Desai, “An introduction to Database Systems”, Galgotia Publication.
6. Majumdar& Bhattacharya, “Database Management System”, Tata Mcgraw-hill Education.
7. Ramakrishnan, Gehrke, “Database Management System”, McGraw Hill (India) Pvt Ltd.
8. Chakravarti, “Advanced Database Mnagement System” Wiley Dreamtech Publications.
9. Ullman, J.D.,"Principles of Database Systems", Galgotia Publications, New Delhi.
10. James Mortin- Principles of Database Management Object Oriented Modeling & Design.

Suggestive digital platforms web links

Electronic media and other digital components in the curriculum:

Name of electronic media: e-SLM	Year of incorporation: 2021

Syllabus for [B.Sc.]: Subject: [Computer science]

<table>
<tr><td colspan="3">Course prerequisites: 10+2 with Computer science, Mathematics</td></tr>
<tr><td>Programme: B.Sc.</td><td>Year: 2</td><td>Semester:4th</td></tr>
<tr><td colspan="3">Subject: Computer science</td></tr>
<tr><td>Course Code: UGCS -104(P)N</td><td colspan="2">Course Title: Practical Work Based on UGCS104 (Introduction to Database Management System)</td></tr>
<tr><td colspan="3">Course Objectives:
• To write SQL commands to query a database.
• To develop database and writing queries using MySQL, SQL Server.
• To write, debug and implement SQL programs in MySQL, SQL Server.
• To learn programming in SQL.</td></tr>
<tr><td colspan="3">Course Outcomes:
CO1. Describe the features of a database system and its application and compare various types of data models.
CO2. Construct an ER Model for a given problem and transform it into a relation database schema.
CO3. Formulate solution to a query problem using SQL Commands, relational algebra, tuple calculus and domain calculus.
CO4. Explain the need of normalization and normalize a given relation to the desired normal form
CO5. Explain different approaches of transaction processing and concurrency control.</td></tr>
<tr><td colspan="2">Credits: 2</td><td>Type of Course: Core</td></tr>
<tr><td colspan="2">Category of Course</td><td>Employability/ skill development/</td></tr>
<tr><td>Max. Marks: 100</td><td colspan="2">Min. Passing Marks: 36</td></tr>
<tr><td colspan="3">Suggestive Practical’s</td></tr>
<tr><td colspan="3">1. Installing SQL Server/MYSQL.
2. Creating Entity-Relationship Diagram using case tools.
3. Writing basic SQL statements.
4. Restricting and sorting data.
5. Displaying data from multiple tables.
6. Aggregating data using group function.
7. Manipulating data.
8. Creating and managing tables.
9. Normalization.
10. Creating procedure and functions etc.
11. Design and implementation of Payroll processing system.
12. Design and implementation of Library Information System.
13. Design and implementation of Student Information System.
14. Automatic Backup of Files and Recovery of Files.</td></tr>
<tr><td colspan="3">Suggested Text Book Readings:
1. Date, C.J.,"An Introduction to Database Systems", Narosa Publishing House, New Delhi.
2. Korth, Silbertz, Sudarshan, “Database Concepts”, Tata Mcgraw-hill Education (India).
3. Elmasri, Navathe, “Fundamentals Of Database Systems”, Pearson Education New Delhi India.
4. G.K. Gupta, “Database Management System”, Tata Mcgraw-hill Education (India) Pvt. Ltd.
5. Bipin C. Desai, “An introduction to Database Systems”, Galgotia Publication.
6. Majumdar& Bhattacharya, “Database Management System”, Tata Mcgraw-hill Education.
7. James Mortin- Principles of Database Management Object Oriented Modeling & Design.</td></tr>
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Suggestive digital platforms web links	
Name of electronic media: e-SLM	Year of incorporation: 2021

Syllabus for [B.Sc.]: Subject: [Computer science]

Course prerequisites: 10+2 with Computer science, Mathematics		
Programme: B.Sc.	Year: 3	Semester:5th
Subject: **Computer science**		
Course Code: DCECS -105N	Course Title: Computer Network	
Course Objectives: • To understand the computer networks and concentrates on building a firm foundation • To provide the fundamental knowledge of the various aspects of computer networking • To understanding the OSI Reference Model and TCP/IP Model • To have a good knowledge of Reference Model Layers and associated protocols. • Analyze the requirements for a given organizational structure. Select the most appropriate networking architecture and technologies and appreciate recent developments in the area.		
Course Outcomes: CO1. Understand computer network basics, network architecture, TCP/IP & OSI reference models and other concepts. CO2. Understand error handling concepts, data link protocols, flow-error control, multi-channel access protocols and Standards CO3. Describe network layer protocols, IP addressing, IPV4 addressing, Routing algorithms, etc. CO4.Describe functionality of Transport layer and related protocols; concept of QoS and techniques. CO5. Define various application layer protocols such as DNS, Electronic Mail, FTP, HTTP, Telnet and understand network security		
Credits: 2		**Type of Course:** Elective
Category of Course		Employability/ skill development/
Max. Marks: 100	Min. Passing Marks: 36	

Block 1	**Computer Network Basics and Services**
Unit I	**Introduction to Computer Network** Computer networks, Network Hardware—Local Area networks, Metropolitan Area networks,, Wide Area networks, Wireless networks, Internetworks, Network Software: Protocol Hierarchies
Unit II	**OSI and TCP/IP Model** Design and Issue for layers, Interfaces and services, Connection oriented and Connection less Services. OSI reference model, and its Evolution, TCP/IP model.
Unit III	. **Unit 3: The Physical Layer:** Physical Layer, Transmission media, twisted pair, Base band and Broadband coaxial cable, Fiber optics, unguided media.
Unit IV	**ISDN and Switching Techniques:** MODEM, ISDN services, Switching Message, Packet Circuit switching TDM, and FDM, ATM, X.25.
Block 2	**Link Layer Issues and Access Protocols**
Unit V	**Data Link Layer:** Data Link Layer, Error detection and Correction, Protocols: Simplex Stop and wait protocols, One bit sliding window protocol, Using Go-Back N. Flow control, Sliding Window Protocol, Channel Allocation Problem
Unit VI	**Multiple Access Protocol:** ALOHA, CSMA protocol, Collision Free protocol, Polling, FDM, TDM

Unit VII	**The Medium Access Sub Layer:** Framing, Static and Dynamic Channel Allocation in LANs and MANs, IEEE Standard 802.3, and Ethernet IEEE standard 802.4 and token Ring, IEEE Standard 802.5, Token Bus
Unit VIII	**Network devices:** Hub, Bridges, Switch, Gateways, Routers.
BLOCK - 3	**IP Addressing and Routing Issues**
Unit IX	**IP Protocol and Addressing:** Network layer design issue, IP Protocol, IP Addresses, subnets,
Unit X	**: Connection Management:** Internetworking, connectionless and connection oriented services, tunneling, Fragmentation, Firewall, Internet Controls Protocols.
Unit XI	**: Routing in Network Layer:** Routing Algorithm, shortest path routing, Flooding, Flow-based routing, Broadcast routing, Congestion Control Algorithm, Congestion control and prevention policies;
Block 4:	**Transport, Session, Presentation and Application Layer**
Unit XII:	**Transport layer:** Transport layer connection management, flow control, error control, congestion control, Establishing and releasing a connection, TCP service Model, TCP protocol
Unit XIII:	**Session and Presentation Layer:** Introduction to cryptography and data compression
Unit XIV:	**The Application Layer:** Network Security, Domain Name System, Email: Architecture and Services, Message formats, Message transfer.
Suggested Text Book Readings: 1. Forouzen, "Data Communication and Networking", TMH A.S. 2. Tanenbaum, Computer Networks, Pearson Education 3. W. Stallings, Data and Computer Communication, Macmillan Press 4. AnuranjanMisra, “Computer Networks”, Acme Learning 5. G. Shanmugarathinam, “Essential of TCP/ IP”, Firewall Media **Suggestive digital platforms web links**	
Electronic media and other digital components in the curriculum: **Choose any one or more than:** e-SLM/Other electronic and digital contents	
Name of electronic media: e-SLM	Year of incorporation: 2021

Syllabus for [B.Sc.]: Subject: [Computer science]

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<tr><td colspan="2">Programme: B.Sc.</td><td colspan="2">Year: 3</td><td>Semester: 5th</td></tr>
<tr><td colspan="5">Subject: Computer science</td></tr>
<tr><td colspan="2">Course Code: DCECS -106N</td><td colspan="3">Course Title: Operating System</td></tr>
<tr><td colspan="5">Course Objectives:
• To develop the understanding of the structure and functioning of Operating System.
• To learn about Processes, Threads and Scheduling algorithms.
• To understand the principles of concurrency and Deadlock.
• To learn various memory management schemes.
• To study I/O management and File systems.</td></tr>
<tr><td colspan="5">Course Outcomes:
CO1. Explain main components, services, types and structure of Operating Systems.
CO2. Apply the various algorithms and techniques to handle the various concurrency control issues.
CO3. Compare and apply various CPU scheduling algorithms for process execution
CO4. Identify occurrence of deadlock and describe ways to handle it
CO5.Explain and apply various memory, I/O and disk management techniques.</td></tr>
<tr><td colspan="3">Credits: 2</td><td colspan="2">Type of Course: Elective</td></tr>
<tr><td colspan="3">Category of Course</td><td colspan="2">Employability/ skill development/</td></tr>
<tr><td colspan="2">Max. Marks: 100</td><td colspan="3">Min. Passing Marks: 36</td></tr>
<tr><td>Block 1</td><td colspan="4"></td></tr>
<tr><td>Unit I</td><td colspan="4">UNIT 1: Introduction
Basic definitions, Batch processing, Multi-programming. Time sharing, multiprocessing; Structure and Functions of Operating System</td></tr>
<tr><td>Unit II</td><td colspan="4">UNIT 2: Process and thread
Process, Process states, State Transitions, Process Control Block, Context Switching, concept of thread, comparison between process and thread, Thread model, thread usage, implementing thread in kernel and user space.</td></tr>
<tr><td>Unit III</td><td colspan="4">. UNIT 3: Process Scheduling
Scheduler, Scheduling criteria, Preemptive and non-preemptive scheduling, Process Scheduling, Process scheduling algorithms.</td></tr>
<tr><td>Unit IV</td><td colspan="4">UNIT 4: Concurrent Process
Process Interaction, Shared Data and Critical Section, Mutual Exclusion, Synchronization, Classical Problems of Synchronization, Semaphores, Monitors.</td></tr>
<tr><td>Block 2</td><td colspan="4"></td></tr>
<tr><td>Unit V</td><td colspan="4">UNIT 5: Deadlock
Concept of deadlock, necessary condition for deadlock, resource allocation graph, deadlock prevention, deadlock avoidance, Banker's algorithm, Deadlock detection, deadlock recovery.</td></tr>
<tr><td>Unit VI</td><td colspan="4">UNIT 6: Memory management
Address Binding, Dynamic Loading and Linking Concepts, Logical and Physical Addresses Contiguous and non-contiguous memory allocation, Paging, Segmentation, Virtual Memory, Demand Paging, Page fault, Page replacement algorithms, thrashing.</td></tr>
<tr><td>Unit VII</td><td colspan="4">UNIT 7: Secondary memory management:
Free Space management, Disk Structure, Disk Scheduling, Formatting, Swap space Management.</td></tr>
<tr><td>Unit VIII</td><td colspan="4">Case Study of UNIX.</td></tr>
<tr><td colspan="5">Suggested Text Book Readings:
1. Abraham Siberschatz and Peter Baer Galvin, “Operating System Concepts”, Addision-Wesley</td></tr>
</table>

<table>
<tr><td colspan="2">2. Milan Milankovic, “Operating Systems, Concepts and Design”, Tata McGraw-Hill.
3. Harvey M Deital, "Operating Systems", Addison Wesley
4. Richard Peterson, “Linux: The Complete Reference”, Osborne Tata McGraw-Hill.
5. SibsankarHalder and Alex A Aravind, “Operating Systems”, Pearson Education
6. D M Dhamdhere, “Operating Systems : A Concept basedApproach”, McGraw Hill.
7. Charles Crowley, “Operating Systems: A Design-Oriented Approach”, Tata McGraw Hill Education”.
8. Stuart E. Madnick& John J. Donovan.Operating Systems.McGraw Hill.
9. A. S. Tanenbaum, "Modern Operating Systems", PHI.
10. William Stallings, "Operating Systems – internals and design principles", PHI.
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Syllabus for [B.Sc.]: Subject: [Computer science]

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<tr><td colspan="2">Programme: B.Sc.</td><td colspan="2">Year: 2</td><td>Semester:4th</td></tr>
<tr><td colspan="5">Subject: Computer science</td></tr>
<tr><td colspan="2">Course Code: DCECS -107(P)N</td><td colspan="3">Course Title: Practical Work Based on DCECS106N Operating System</td></tr>
<tr><td colspan="5">Course Objectives:
• To develop the understanding of the structure and functioning of Operating System.
• To learn about Processes, Threads and Scheduling algorithms.
• To understand the principles of concurrency and Deadlock.
• To learn various memory management schemes.
• To study I/O management and File systems.</td></tr>
<tr><td colspan="5">Course Outcomes:
CO1. Explain main components, services, types and structure of Operating Systems.
CO2. Apply the various algorithms and techniques to handle the various concurrency control issues.
CO3. Compare and apply various CPU scheduling algorithms for process execution
CO4. Identify occurrence of deadlock and describe ways to handle it
CO5.Explain and apply various memory, I/O and disk management techniques.</td></tr>
<tr><td colspan="3">Credits: 2</td><td colspan="2">Type of Course: Core</td></tr>
<tr><td colspan="2">Max. Marks: 100</td><td colspan="3">Min. Passing Marks: 36</td></tr>
<tr><td>Block 1</td><td colspan="4"></td></tr>
<tr><td></td><td colspan="4">• Installing operating systems.
• Run the basics Linux commands.
• Writing code to implement scheduling Algorithams.
• Try to learn perform the various memory management schemes</td></tr>
<tr><td colspan="5">Suggested Text Book Readings:
1. Abraham Siberschatz and Peter Baer Galvin, “Operating System Concepts”, Addision-Wesley
2. Milan Milankovic, “Operating Systems, Concepts and Design”, Tata McGraw-Hill.
3. Harvey M Deital, "Operating Systems", Addison Wesley
4. Richard Peterson, “Linux: The Complete Reference”, Osborne Tata McGraw-Hill.
5. SibsankarHalder and Alex A Aravind, “Operating Systems”, Pearson Education
6. D M Dhamdhere, “Operating Systems : A Concept basedApproach”, McGraw Hill.
7. Charles Crowley, “Operating Systems: A Design-Oriented Approach”, Tata McGraw Hill Education”.
8. Stuart E. Madnick& John J. Donovan.Operating Systems.McGraw Hill.
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Syllabus for [B.Sc.]: Subject: [Computer science]

<table>
<tr><td colspan="3">Course prerequisites: 10+2 with Computer science, Mathematics</td></tr>
<tr><td>Programme: B.Sc.</td><td>Year: 3</td><td>Semester: 6th</td></tr>
<tr><td colspan="3">Subject: Computer science</td></tr>
<tr><td>Course Code: DCECS -108N</td><td colspan="2">Course Title: C++ and Object Oriented Programming</td></tr>
<tr><td colspan="3">Course Objectives:
• To understand Object Oriented Concepts using C++ Language
• To develop, debug and document programs in C++ using OOP paradigms.
• Describe the meaning of the object-oriented paradigm and implement real-world entities like inheritance, hiding, polymorphism in programming using the object-oriented design process.</td></tr>
<tr><td colspan="3">Course Outcomes:
CO1 To understand Object Oriented Concepts using C++ and understand/implement C++ programming basics as data types, variable, constants, operators, control statements, arrays, etc.
CO2. To understand and implement concepts of inheritance, hiding, polymorphism,interfaces and packages etc. in C++ programming.</td></tr>
<tr><td colspan="2">Credits: 2</td><td>Type of Course: Elective</td></tr>
<tr><td>Max. Marks: 100</td><td colspan="2">Min. Passing Marks: 36</td></tr>
<tr><td>Block 1</td><td colspan="2"></td></tr>
<tr><td>Unit I</td><td colspan="2">UNIT 1: Principles of object oriented programming
Object oriented programming paradigm, Comparison with procedural programming, Basic concepts of object oriented programming, benefits of O0P, object oriented Languages, advantage of C++.</td></tr>
<tr><td>Unit II</td><td colspan="2">UNIT 2: Object Orient Programming System
Class, inheritance, abstraction, encapsulation and information hiding, polymorphism, overloading.</td></tr>
<tr><td>Unit III</td><td colspan="2">UNIT 3: Advanced concept
Dynamism (Dynamic typing., dynamic binding, late binding, dynamic loading). Structuring programs, reusability, organizing object oriented project,</td></tr>
<tr><td>Block 2</td><td colspan="2">Overview of C++</td></tr>
<tr><td>Unit IV</td><td colspan="2">Tokens, keywords, identifiers and constants basic data types, user-defined and derived Data types, type compatibility, reference, variables type Casting, operator precedence, control structures, structure, function.</td></tr>
<tr><td>Unit V</td><td colspan="2">Classes and objects
Class specification, class objects, accessing class members, scope resolution operator, data hiding, empty classes, Pointers within a class, passing objects as arguments, returning objects from functions, friend Functions and friend classes, constant parameters and member functions, structures and Classes, static members.</td></tr>
<tr><td>Unit VI</td><td colspan="2">Object initialization and cleanup
Constructors destructor, constructor overloading. order of construction and destruction, Constructors with default arguments, nameless objects, dynamic initialization through Constructors, constructors with dynamic operations, constant objects and constructor, static Data members with constructors and destructors, nested classes</td></tr>
<tr><td>BLOCK - 3</td><td colspan="2"></td></tr>
<tr><td>Unit VII</td><td colspan="2">UNIT 8: Operator overloading and type conversion
Defining operator overloading, overloading unary operators, overloading binary operators, overloading binary operators using friends, manipulation of strings using Operators, rules for overloading operators. type conversions.</td></tr>
<tr><td>Unit VIII</td><td colspan="2">UNIT 9: Inheritance: extending classes
Deriving derived classes, single multilevel, multiple, hierarchical, hybrid inheritance,</td></tr>
</table>

	Constructors & destructors in derived classes, constructors invocation and data members Initialization, virtual base classes, abstract classes, delegation.
BLOCK- 4	
	UNIT 10: Pointers, virtual functions and polymorphism Pointers to objects, this pointer. pointers to derived classes, virtual functions, Implementation of run-time polymorphism, pure virtual functions.
	UNIT 11: Working with files Classes for file stream operations. opening and closing a file, file pointers and their Manipulations, sequential input and output operations, error handling during file Operations, command line arguments.
	UNIT 12: Object Oriented Modeling Need of object oriented Modeling, Simulation of real life problems using OOP concept: Example, Representation of problem using object and class diagrams at design level.
Suggested Text Book Readings: A.R.Venugopal, Rajkumar, T. Ravishanker "Mastering C++", TMH. R.Lafore, "Object Oriented Programming using C++", Galgotia Publications. E. Balagurusamy, "Object Oriented Programming with C++", TMH. **Suggestive digital platforms web links:**	
Electronic media and other digital components in the curriculum: **Choose any one or more than:**e-SLM/Other electronic and digital contents	
Name of electronic media: e-SLM	Year of incorporation: 2022

Syllabus for [B.Sc.]: Subject: [Computer science]

<table>
<tr><td colspan="3">Course prerequisites: 10+2 with Computer science, Mathematics</td></tr>
<tr><td>Programme: B.Sc.</td><td>Year: 3</td><td>Semester: 6th</td></tr>
<tr><td colspan="3">Subject: Computer science</td></tr>
<tr><td>Course Code: DCECS -109N</td><td colspan="2">Course Title: Software Engineering</td></tr>
<tr><td colspan="3">Course Objectives:
1. To understand the methodologies involved in the development and maintenance of software (i.e.) over the entire life cycle.
2. To learn about generic models of software development process.
3. To understand methods of capturing, specifying, visualizing and analyzing software requirements and analysis modeling.
4. To know basics of testing and understanding concept of software quality assurance and software configuration management process.
5. To understand the different design techniques and their implementation.
6. To learn various testing and maintenance measures.
7. To understand Project management and Quality Assurance plan and measures.</td></tr>
<tr><td colspan="3">Course Outcomes:
CO1. Understand and comprehend the nature of software development and software life cycle models
CO2. Explain needs for software specifications, software requirements and their gathering techniques and their application.
CO3. Understand and comprehend software quality assurance techniques.
CO4. Learn and implement concepts of software design modeling and principles
CO5. Compare, understand and learn different testing strategies and tactic
CO6. Understand, compare and apply various software maintenance and management techniques</td></tr>
<tr><td colspan="2">Credits: 2</td><td>Type of Course: Elective</td></tr>
<tr><td colspan="2">Max. Marks: 100</td><td>Min. Passing Marks: 36</td></tr>
<tr><td>Block 1</td><td colspan="2"></td></tr>
<tr><td>Unit I</td><td colspan="2">UNIT-I Software Engineering Fundamentals: Definition of Software, Software characteristics, Software Applications. Software Process: Software Process Models - Waterfall model, prototyping model, spiral model, incremental model, concurrent development model. Project management Concepts: The Management Spectrum - The People, The Product The Process, The Project.</td></tr>
<tr><td>Unit II</td><td colspan="2">UNIT-II Software Process and Project Metrics : Measures , Metrics and Indicators , Software measurement Size -Oriented Metrics , Function - Oriented Metrics , Extended Function point metrics Software Project Planning : Project Planning Objectives , Software Project Estimation , Decomposition Techniques - Problem Based Estimation Process Based Estimation ,Empirical Estimation Models- The COCOMO Model Risk Analysis and Management: Software risks, Risk identification, Risk Projection, Risk Refinement, Risk Mitigation , Monitoring and Management.</td></tr>
<tr><td>Unit III</td><td colspan="2">UNIT-III Software Quality Assurance: Basic concepts- Quality, Quality Control, Quality Assurance, Cost of Quality , Software Quality Assurance (SQA) , Formal Technical Review Software Configuration Management: Baselines , Software Configuration Items, The SCM Process, Version Control, Change Control, Configuration Audit, Status Reporting. Analysis Concepts and Principles: Requirements Elicitation for Software, Analysis Principles. The Information Domain, Modeling, Partitioning, Essential and Implementation Views, Specification: Specification Principles, Representation, The Software Requirement Specification (SRS)</td></tr>
<tr><td>Block 2</td><td colspan="2"></td></tr>
</table>

Unit IV	**UNIT-IV Design Concepts and Principles:** Design Principles, Design Concepts — Abstraction, Refinement, Modularity, Software Architecture, Control Hierarchy, Structural Partitioning, Data Structure. Software Procedure, Structure, Information Hiding, Effective Modular Design- Cohesion, Coupling Software Testing: Testing Objectives & principles, Unit Testing, Integration Testing (Top Down Integration , Bottom. Up Integration, Regression Testing, Smoke Testing), Validation Testing (Alpha and Beta Testing), System Testing (Recovery Testing, Security Testing, Stress Testing, Performance Testing).
Unit V	**UNIT-V Reengineering:** Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering CASE Tools: What is CASE, Building Blocks of CASE, A Taxonomy of CASE Tools, Integrated CASE Environments, The integration Architecture, The CASE Repository.

Suggested Text Book Readings:

R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.

Rajib Mall, Fundamentals of Software Engineering, PHI Publication.

K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.

Pankaj Jalote, Software Engineering, Wiley.

Deepak Jain,"Software Engineering: Principles and Practices", Oxford University Press.

Munesh C. Trivedi, Software Engineering, Khanna Publishing House.

N.S. Gill, Software Engineering, Khanna Publishing House.

Suggestive digital platforms web links:

Electronic media and other digital components in the curriculum:

Name of electronic media: e-SLM	Year of incorporation: 2022

Syllabus for [B.Sc.]: Subject: [Computer science]

<table>
<tr><td colspan="3">Course prerequisites: 10+2 with Computer science, Mathematics</td></tr>
<tr><td>Programme: B.Sc.</td><td>Year:3</td><td>Semester:6th</td></tr>
<tr><td colspan="3">Subject: Computer science</td></tr>
<tr><td>Course Code: DCECS -110(P)N</td><td colspan="2">Course Title: Practical Work based on 108</td></tr>
<tr><td colspan="3">Course Objectives:
1. To write, compile, debug and execute programs in a C programming environment.
2. To learn programs that incorporate use of variables, operators and expressions along with data types.
3. To learn programs for solving problems involving use of decision control structures and loops.
4. To learn programs that involve the use of arrays, structures and user defined functions.
5. To Write programs using file handling operations.</td></tr>
<tr><td colspan="3">Course Outcomes:
CO1. Write, compile, debug and execute programs in a C programming environment
CO2. Write programs that incorporate use of variables, operators and expressions along with data types.
CO3. Write programs for solving problems involving use of decision control structures and loops.
CO4. Write programs that involve the use of arrays, structures and user defined functions
CO5. Write programs using file handling operations.</td></tr>
<tr><td colspan="2">Credits:2</td><td>Type of Course: Elective</td></tr>
<tr><td>Max. Marks: 100</td><td colspan="2">Min. Passing Marks: 36</td></tr>
<tr><td>Unit I</td><td colspan="2">Program to implement conditional statements in C++ language.
• Program to implement switch-case statement in C++ language
• Program to implement looping constructs inC++ language.
• Program to perform basic input-output operations in C++ language.
• Program to implement user defined functions in C++ language.
• Program to implement recursive functions in C++ language.
• Program to implement one-dimensional arrays in C++ language.
• Program to implement two-dimensional arrays in C++ language.
• Program to perform various operations on two-dimensional arrays in C++ language.
• Program to implement multi-dimensional arrays in C++ language.
• Program to implement string manipulation functions in C++ language.
• Program to implement structure in C++ language.
• Program to implement union in C++ language.
• Program to perform file handling operations in C ++language.</td></tr>
<tr><td colspan="3">Suggested Text Book Readings:
A.R.Venugopal, Rajkumar, T. Ravishanker “Mastering C++”, TMH.
R.Lafore, “Object Oriented Programming using C++”, Galgotia Publications.
E. Balagurusamy, “Object Oriented Programming with C++”, TMH.</td></tr>
</table>