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Annexure – 2A

Syllabus Structure of Undergraduate B.Tech - 4 Years

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Computer Science & Technology (CSE) Program

SL. NO.	COURSE WORK - SUBJECTS AREA	CREDITS / SEMESTER								TOTAL CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences including Management Courses	3	3	2	2	-	-	3	-	**13**
2	Basic Science Courses	8	8	4	-	-	-	-	-	**20**
3	Engineering Science Courses including workshop, drawing, basics of electrical mechanical/computer etc.	10	10	4	3	-	-	-	-	**27**
4	Professional Core Courses	-	-	12	15	15	10	-	-	**52**
5	Professional Elective Courses relevant to chosen specialization / branch	-	-	-	-	3	6	6	3	**18**
6	Open subjects - Electives from other technical and/or emerging Subjects	-	-	-	-	3	3	3	6	**15**
7	Project work, Seminar and Internship in industry or elsewhere	-	-	1	-	1	-	5	8	**15**
8	Mandatory Courses [Environmental Sciences, Induction Training, Indian Constitution, Essence of Indian Traditional Knowledge]	0	0	0	0	-	-	-	-	**0**
	TOTAL	**21**	**21**	**23**	**20**	**22**	**19**	**17**	**17**	**160**

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I Semester [First Year]

Computer Science & Engineering

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Basic Science Courses		Engineering Mathematics-I	3	1	0	4
2	Basic Science Courses		Engineering Physics / Engineering Chemistry	3	0	2	4
3	Engineering Science Courses		Basic Electronics / Basic Electrical Engineering	3	0	2	`4
4	Engineering Science Courses		Programming for Problem Solving	2	0	4	4
5	Humanities and Social Sciences including Management Courses		Communicative English & Soft Skills	2	0	2	3
6	Engineering Science Courses		Engineering Graphics & Design / Workshop (Branch Specific)	1	0	2	2
7	Mandatory Courses		Induction Program	-	-	-	0
			Total Credits:	**14**	**1**	**12**	**21**

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II Semester [First Year]

Computer Science & Engineering

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Basic Science Courses		Engineering Mathematics-II	3	1	0	4
2	Basic Science Courses		Engineering Chemistry / Engineering Physics	3	0	2	4
3	Engineering Science Courses		Basic Electrical Engineering / Basic Electronics	3	0	2	4
4	Engineering Science Courses		Data Structure & Algorithms	2	0	4	4
5	Humanities and Social Sciences including Management Courses		Communicative English & Technical Communication	2	0	2	3
6	Engineering Science Courses		Engineering Workshop (Branch Specific) / Engineering Graphics & Design	1	0	2	2
7	Mandatory Courses		NCC/NSS/Yoga	-	-	-	0
			Total Credits:	**14**	**1**	**12**	**21**

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III Semester [Second Year]

Computer Science & Engineering

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Basic Science Courses		Discrete Mathematics	3	1	0	4
2	Engineering Science Courses		Data Base Management Systems	3	0	2	4
3	Professional Core Courses		Digital Electronics	3	0	2	4
4	Professional Core Courses		Operating Systems	3	0	2	4
5	Professional Core Courses		Object Oriented Programming through Java	3	0	2	4
6	Humanities and Social Sciences including Management Courses		Organizational Behavior / Optimization in Engineering	2	0	0	2
7	Project		Summer Industry Internship	-	-	2	1
8	Mandatory Courses		Environmental Sciences	-	-	-	0
			Total Credits:	**17**	**1**	**10**	**23**

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IV Semester [Second Year]

Computer Science & Engineering

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Engineering Science Courses		Fundamental of Python Programming	2	0	2	3
2	Professional Core Courses		Computer Organization & Architecture	3	0	2	4
3	Professional Core Courses		Design and Analysis of Algorithms	3	0	2	4
4	Professional Core Courses		Computer Networks	3	0	2	4
5	Professional Core Courses		Formal Language & Automata Theory	3	0	0	3
6	Humanities and Social Sciences including Management Courses		Marketing Management / Engineering Economics and Costing	2	0	0	2
7	Mandatory Courses		Constitution of India/ Essence of Indian Knowledge Tradition	-	-	-	0
			Total Credits:	**16**	**0**	**8**	**20**

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V Semester [Third Year]

Computer Science & Engineering

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Professional Core Courses		Artificial Intelligence	3	0	0	3
2	Professional Core Courses		Compiler Design	3	0	0	3
3	Professional Core Courses		Internet of Things	3	0	2	4
4	Professional Core Courses		Data Mining & Data Warehousing	3	0	2	4
5	Professional Elective Courses		Professional Elective - 1	3	0	0	3
6	Open Elective Courses		Open Elective - 1	3	0	0	3
7	Project		Summer Industry Internship	-	-	2	1
			Total Credits:	**18**	**0**	**8**	**21**

Sl. No.	Specialization	Professional Elective - 1
1.	Artificial Intelligence & Machine Learning	Fuzzy logic and its applications
		Digital Image Processing
2.	Data Science	Information Storage and Management
		Data Preparation and Analysis
3.	Cyber Security	Information Security
		Cyber Security and Information Assurance
4.	Internet of Things	Wireless Sensor Networks
		Mobile Computing

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VI Semester [Third Year]

Computer Science & Engineering

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Professional Core Courses		Software Engineering	3	0	2	4
2	Professional Core Courses		Computer Graphics	3	0	0	3
3	Professional Core Courses		Microprocessors and Microcontrollers	3	0	0	4
4	Professional Elective Courses		Professional Elective - 2	3	0	0	3
5	Professional Elective Courses		Professional Elective - 3	3	0	0	3
6	Open Elective Courses		Open Elective - 2	3	0	0	3
			Total Credits:	**18**	**0**	**2**	**20**

Sl. No.	Specialization	Professional Elective - 2	Professional Elective - 3
1.	Artificial Intelligence & Machine Learning	Genetic Algorithm and its Applications	Artificial Neural Networks
		Computational Neuroscience	Advanced Algorithms
2.	Data Science	Introduction to Data Science	Machine Learning
		Web Intelligence	Business Intelligence and Analytics
3.	Cyber Security	Cryptography & Network Security	Mobile and Wireless Network Security
		Audit and Risk Assessment	Malware Analysis
4.	Internet of Things	IOT Architecture and Protocols	Applications of IOT
		Software Defined Networks	Data Centric Networks

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VII Semester [Fourth Year]

Computer Science & Engineering

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Professional Elective Courses		Professional Elective - 4	3	0	0	3
2	Professional Elective Courses		Professional Elective - 5	3	0	0	3
3	Open Elective Courses		Open Elective - 3	3	0	0	3
4	Humanities and Social Sciences including Management Courses		Entrepreneurship Development / Human Resource Management	2	1	0	3
5	Project		Summer Industry Internship	-	-	2	1
6	Project		Project Work-I	0	0	8	4
			Total Credits:	**11**	**1**	**10**	**17**

Sl. No.	Specialization	Professional Elective - 4	Professional Elective - 5
1.	Artificial Intelligence & Machine Learning	Statistical Machine Learning	Deep Learning
		Intelligent Machining	Robotics: Computational Motion Planning
2.	Data Science	Artificial Neural Network	Big data & Visualization
		High Performance Computing	Statistical Computing
3.	Cyber Security	Cloud Security	Cyber Law
		Database Security	Biometrics
4.	Internet of Things	IOT Security	Machine Learning
		Embedded IOT	Network Programming

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VIII Semester [Fourth Year]

Computer Science & Engineering

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits
				L	T	P	
1	Professional Elective Courses		Professional Elective - 6	3	0	0	3
2	Open Elective Courses		Open Elective - 4	3	0	0	3
3	Open Elective Courses		Open Elective - 5	3	0	0	3
4	Project		Project Work-II & Dissertation	0	0	16	8
			Total Credits:	**9**	**0**	**16**	**17**

Sl. No.	Specialization	Professional Elective - 6
1.	Artificial Intelligence & Machine Learning	Computer Vision
		Natural Language Processing
2.	Data Science	Deep Learning
		Streaming Analytics
3.	Cyber Security	Security Governance, Risk and Compliance
		Operation System Security
4.	Internet of Things	Energy Management for IOT devices
		Edge Computing

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BUCKETS FOR PROFESSIONAL ELECTIVES AND OPEN ELECTIVES

Computer Science & Engineering

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING	DATA SCIENCE	CYBER SECURITY	INTERNET OF THINGS	OPEN ELECTIVES
Fuzzy Logic and its Applications	Information Storage and Management	Information Security	Wireless Sensor Networks	Soft Skills and Interpersonal Communication
Digital Image Processing	Data Preprocessing and Analysis	Cyber Security and Information Assurance	Mobile Computing	Human Resource Development
Genetic Algorithm and its Applications	Introduction to Data Science	Cryptography and Network Security	IOT Architecture and Protocols	Cyber Law and Ethics
Computational Neuroscience	Web Intelligence	Audit and Risk Assessment	Software Defined Networks	Economic Policies in India
Artificial Neural Networks	Machine Learning	Mobile and Wireless Network Security	Applications of IoT	Introduction to Art and Aesthetics
Advanced Algorithms	Business Intelligence and Analytics	Malware Analysis	Data Centric Networks	Indian Music System
Statistical Machine Learning	Artificial Neural Network	Database Security	IOT Security	Data Analysis using Open Source Tool
Intelligent Machining	High Performance Computing	Cloud Security	Embedded IoT	IT Infrastructure Management
Deep Learning	Big Data & Visualization	Cyber Law	Machine Learning	Android Development
Robotics: Computational Motion Planning	Statistical Computing	Biometrics	Network Programming	IOS Development
Computer Vision	Deep Learning	Security Governance, Risk and Compliance	Energy Management for IOT devices	Mobile Application Development
Natural Language Processing	Streaming Analytics	Operation System Security	Edge Computing	Soft Computing

Note: On-line MOOC courses may contribute up to 20% of the credits, with in-house examination being conducted.

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Computer Science & Engineering

Structure of Undergraduate Engineering program:

Basket	Basket Category	%	Credits to be acquired		
			Theory Course	Practice Course	Total Credits
1	Humanities and Social Sciences including Management courses	**8.1**	11	02	**13**
2	Basic Science courses	**12.5**	18	02	**20**
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	**16.9**	17	10	**27**
4	Professional core courses	**31.9**	42	09	**51**
5	Professional Elective courses relevant to chosen specialization/branch	**11.3**	18	00	**18**
6	Open subjects – Electives from other technical and /or emerging subjects	**9.4**	15	00	**15**
7	Project work, seminar and internship in industry or elsewhere	**9.4**	00	15	**15**
8	Mandatory Courses: [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge]	**0**	00	00	**0**
	Total		**122**	**38**	**160**

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Computer Science & Engineering (CSE) Program

Humanities and Social Sciences including Management Courses (HSMC)

SL. NO.	Code No.	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1		Communicative English & Soft Skills(CESS)	2	0	2	3	I
2		Communicative English & Technical Communication(CETC)	2	0	2	3	II
3		Organizational Behavior	2	0	0	2	III
4		Engineering Economics and Costing	2	0	0	2	IV
5		Entrepreneurship Development	2	1	0	3	VII
Total Credits						13	

Basic Science courses (BSC)

SL. NO.	Code No.	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1		Engineering Mathematics-I	3	1	0	4	I
2		Engineering Physics	3	0	2	4	I/II
3		Engineering Chemistry	3	0	2	4	I/II
4		Engineering Mathematics-II	3	1	0	4	II
5		Discrete Mathematics	3	1	0	4	III
Total Credits						20	

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Computer Science & Engineering (CSE) Program

Engineering Science Course (ESC)

SL. NO.	Code No.	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1		Basics of Electronics / Basic Electrical Engineering	3	0	2	4	I
2		Programming for Problem Solving	2	0	4	4	I
3		Engineering Graphics & Design	1	0	2	2	I/II
4		Workshop (Branch Specific)	1	0	2	2	I/II
5		Basic Electrical Engineering / Basics of Electronics	3	0	2	4	II
6		Data Structure & Algorithms	2	0	4	4	II
7		Data Base Management Systems	3	0	2	4	III
8		Fundamental of Python Programming	2	0	2	3	IV
Total Credits						27	

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Professional Core Courses (PCC)

SL. NO.	Code No.	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1		Digital Electronics	3	0	2	4	III
2		Operating Systems	3	0	2	4	III
3		Object Oriented Programming through Java	3	0	2	4	III
4		Computer Organization & Architecture	3	0	2	4	IV
5		Design and Analysis of Algorithms	3	0	2	4	IV
6		Formal Language & Automata Theory	3	0	0	3	IV
7		Computer Networks	3	0	2	4	IV
8		Artificial Intelligence	3	0	0	3	V
9		Data Mining & Data Warehousing	3	0	0	4	V
10		Compiler Design	3	0	2	4	V
11		Internet of Things	3	0	2	3	V
12		Computer Graphics	3	0	0	3	VI
13		Software Engineering	3	0	2	4	VI
14		Microprocessor and Microcontrollers	3	0	0	3	VI
Total Credits						52	

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Computer Science & Engineering (CSE) Program

Professional Elective Courses (PEC)

SL. NO.	Code No.	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1		Professional Elective - 1	3	0	0	3	V
2		Professional Elective - 2	3	0	0	3	VI
3		Professional Elective - 3	3	0	0	3	VI
4		Professional Elective - 4	3	0	0	3	VII
5		Professional Elective - 5	3	0	0	3	VII
6		Professional Elective - 6	3	0	0	3	VIII
Total Credits						18	

Open Elective Courses (OEC)

SL. NO.	Code No.	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1		Open Elective - 1	3	0	0	3	V
2		Open Elective - 2	3	0	0	3	VI
3		Open Elective - 3	3	0	0	3	VII
4		Open Elective - 4	3	0	0	3	VIII
5		Open Elective - 5	3	0	0	3	VIII
Total Credits						15	

Computer Science & Engineering (CSE) Program

Project work, seminar and internship in industry or elsewhere

SL. NO.	Code No.	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1		Summer Industry Internship	-	-	2	1	III
2		Summer Industry Internship	-	-	2	1	V
3		Summer Industry Internship	-	-	2	1	VII
4		Project Work-I	0	0	8	4	VII
5		Project Work-II & Dissertation	0	0	16	8	VIII
Total Credits						15	

Mandatory Courses (MC)

SL. NO.	Code No.	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1		Induction Program	-	-	-	0	I
2		NCC/NSS/Yoga	-	-	-	0	II
3		Environmental Sciences	-	-	-	0	III
4		Constitution of India/ Essence of Indian Knowledge Tradition	-	-	-	0	IV
Total Credits						0	

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Annexure – 3A

Detailed Syllabus of Undergraduate B.Tech - 4 Years

Computer Science & Engineering (CSE) Program

I Semester [First Year]

Course Code	Course Title	L	T	P	C	
BESBS1040	**Programming for Problem Solving**	**2**	**0**	**0**	**2**	
Pre -Requisite: Computer basics.						

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Course Educational Objective	
CEO1: To formulate algorithm, translate into program and then execute the programs for verifying its correctness.	
CEO2: To analyze a problem for knowing its efficiency and decompose it into functions using divide and conquer approach.	
Course Outcome: Student should be able to	
CO1	Formulate simple algorithms for arithmetic and logical problems and translate into programs.
CO2	Understand and develop programs using loop, arrays and analyse its complexity.
CO3	Understand and develop programs using strings, functions and recursions.
CO4	Develop programs using pointers and structures, and understand their functionality.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1									
CO2	1	3	2									
CO3	1	3	3									
CO4	2	2	3									

UNIT- I **(10 Hours)**

Programming: Introduction to Structured Programming Approach, Basic structure of C program, C compilers, Compilation and Execution Process, Error debugging.

C Tokens**,** keywords, identifiers, data types, constants, variables, standard I/O statements, Operators classifications**,** Operator precedence and Associativity, Implicit and Explicit type casting. Control Flow Statements: **Selection Logic**: if, if..else, else if ladder, nested if, switch..case.

UNIT- II **(10 Hours)**

Iteration Logic: while, do-while and for loop, break, continue, nested loop.

Arrays: 1-D Array: declaration, initialization, array operations, 2-D Array: declaration, Initialization, 2-D array operations

UNIT- III **(10 Hours)**

Character arrays and Strings: String handling operations, strcmp(), strcat(), strcpy(), strlen().

User Defined Functions: Function categories, Parameter passing in functions, Passing arrays to functions, Recursive functions,storage classes

UNIT- IV **(10 Hours)**

User Defined Data Types: S**tructures**: Declaration and initialization of structures, accessing structure elements , nested structures, structures and arrays, structures and functions, typedef

Pointers: Declaration and initialization of pointers, Pointer arithmetic, Pointer and Arrays, call by value and call by address, Function returning pointer, pointer to structure, Dynamic memory allocation.

Text Books:

1) E. Balaguruswamy, Programming in ANSI C, 7th edition, Tata McGraw-Hill

2) Let us 'C' by Yashwant Kanethekar, 16th edition, BPB Publications
3) Byron Gottfried, Schaum's Outline of Programming with C, 3rd edition, McGraw-Hill

References:

1) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language,2nd edition, Prentice Hall of India
2) Programming in C, by Reema Thareja, 2nd Edition, OUP India
3) C Programming and Coding by Swatisaxena, BPB Publications.

Course Code	Course Title	L	T	P	C	
BESBS1140	**Programming for Problem Solving Laboratory**	**0**	**0**	**4**	**2**	

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Pre -Requisite:	
Course Educational Objective	
CEO1: To develop programs for problems on different applications of array, functions, pointers and structure.	
CEO2: To analyse different problems by comparing and implementing in programming.	
Course Outcome	
CO1	To understand operating system and its simple commands, writing programs, compilation, debug and execution process.
CO2	To develop programs using loop controls, arrays and understand the complexity using different programs.
CO3	To develop programs using functions and recursive function by decomposing a problem and analyse them.
CO4	To Solve numerical problems, develop different programs using pointers, structures and analyse their functionality.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**1**									
CO2	**1**	**2**	**2**	**1**								
CO3	**1**	**2**	**2**	**1**								
CO4	**1**	**2**	**2**	**1**								

Lab Experiment 1: Familiarization with programming environment

1) Introduction to OS: Before starting experiments explain the facilities and operations of OS.

2) Introduction to the C compiler, Compilation and Execution Process & writing simple programs.

Lab Experiment 2: Simple computational problems using arithmetic expressions.

1) WAP to input radius of a circle and Find the area, perimeter of it.

2) WAP to input two numbers and swap them without using intermediate variable.

Lab Experiment 3: Simple computational problems using arithmetic expressions.

1) Write a program to accept Fahrenheit and calculate its equivalent Celsius.

2) WAP to input three unequal numbers and find the greatest using conditional operator.

Lab Experiment 4: Problems involving if, switch

1) Write a program to input a lower case alphabet and test whether it is vowel or consonant. (using else..if and switch both)

2) Write a program to find the greatest among three numbers. (using else..if and switch both)

Lab Experiment 5: while, do..while and for loops:

1) Write a program to find the Greatest Common Divisor of two integers using while statement.

2) Write a program to accept a positive integer and test it for Armstrong or not using do..while statement.

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Lab Experiment 6: Nested Loop

1) Write a program to calculate the following sum using nested for statement:

Sum = 1-(x^2)/2! +(x^4)/4! – (x^6)/6! + (x^8)/8! – (x^10)/10!

2) Write a program to generate the following pyramid using nested for statement:

```
        1
      1 2 1
    1 2 3 2 1
  1 2 3 4 3 2 1
```

Lab Experiment 7: 1D Array interaction

1) Write a program to accept 10 integers in to an array and find largest and smallest integers present in them.

2) Write a program to input 10 elements into an array. Then search for a given value in the array to know its existence.

Lab Experiment 8: 2D Array interaction

3) Write a program to input values into two matrices A(3x4), B(4x3). Perform matrix multiplication and display the resultant matrix.

4)Write a program to input two strings and test whether they are equal or not using string handling functions.

Lab Experiment 9: User Defined Functions

1) Write a C program which contains three UDF's namely add(), subtract() and multiply(). Each function accepts two integers as their arguments and calculate and return the results

2) Write a program to create an UDF and test a number is prime or not.

Lab Experiment 9: Recursive Functions

1) Write a program to accept 10 elements into an integer array. Find the largest element present using recursive function.

2) Write a program to generate Fibonacci series using a recursive function.

Lab Experiment 10:structures

1) Write a program to store 11 cricket players' details into an array of structure. The structure having member's player name, team name and batting average. Displays the name of players whose batting average is >=30.

2) Write a program to create a structure COMPLEX. Input two complex numbers using UDF and find the sum of them.

Lab Experiment 11: Pointers and Dynamic Memory Allocation

1) Write a program to create user defined function called swap having two integer pointers as its arguments and it has no return value. Call this function using call-by-address.

2) Write a program to store 'n integers using dynamic memory allocation. Find the average value of the integers using a user defined function.

Lab Experiment 12: structure with pointer

1) Write a program create a structure PRODUCT having members Product no, Name and Price. Using a pointer Input 5 product details into a structure array and then display those products whose price is >1000 rupees.

2) Write a program to create a structure EMPLOYEE to store N employee details i.e: employee no, name, salary. Display only those employee names whose salary>=50000.

Teaching Methods: Chalk& Board/ PPT/Video Lecture • A case study can be given to each student for each UNIT. • A Mini Project can be given which the student have to do during the semester break.
Text Books: 4) E. Balaguruswamy, Programming in ANSI C, 7th edition, Tata McGraw-Hill 5) Let us 'C' by Yashwant Kanethekar, 16th edition, BPB Publications 6) Byron Gottfried, Schaum's Outline of Programming with C, 3rd Edition, McGraw-Hill
References: 4) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language,2nd edition, Prentice Hall of India 5) Programming in C, by Reema Thareja, 2nd Edition, OUP India 6) C Programming and Coding by Swatisaxena, BPB Publications

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Course Code	Course Title	L	T	P	C	
BESBS2040	**DATA STRUCTURE AND ALGORITHMS**	**2**	**0**	**0**	**2**	

Pre -Requisite: Basic knowledge of Algorithms

Course Educational Objective

CEO1:Develop algorithms for performing different operations on arrays, stack, Queue, linked list. Analyze the difference between them and understand different applications. Understand different searching and sorting methods and applications.

CEO2:Understand and analyze Binary search Tree, AVL Tree, Heap Tree and their applications. Understand the memory representation of graph, its traversal methods and applications. Analyze the Hashing techniques in compare with other sorting techniques.

Course Outcome: student can able to

CO1	Develop algorithms for performing different operations on 1D array, matrix, stack, Queue, analyze the difference between them and understand different applications.
CO2	Understand different searching and sorting methods, Linked lists and them compare them in terms of performance and applications.
CO3	Understand the Binary Tree and its memory representation; analyze Binary search Tree and its applications, compare the BST with AVL Tree, Heap Tree and examine the advantages.
CO4	Understand the memory representation of graph; analyze traversal methods and applications of graph. Analyze the Hashing techniques in compare with other sorting techniques.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2									
CO2	3	2	3									
CO3	3	3	3									
CO4	2	3	2									

UNIT- I **(11 Hours)**

Basic concepts: Data abstraction, Data structures and types. Algorithm specification, 1D array: operations, 2D array: row major order and column major order.

Stack: Basic concepts, operations and implementation of stack using arrays, Mathematical procedure for conversions of arithmetic expressions. Applications of stack: infix to postfix conversion and postfix evaluation. Queue: Linear queue, operations and implementation using arrays, circular queue and its operations, Basics concepts of Double ended Queue and priority queue

UNIT- II **(11 Hours)**

Searching: Linear search and Binary search on elements in a linear array. Sorting: Bubble sort, Insertion sort, Selection sort using linear array. Linked Lists: Basic concepts and operations of single linked list, linked stack, linked queue, circular single linked list, and

Doublelinked list. Basic concept of Circular double linked list.
UNIT- III **(11 Hours)** Trees: Introduction, Terminology, Binary Trees, Memory Representation of Binary Trees using arrays and linked lists, Binary Tree traversal methods(recursive and non-recursive) , Construction of binary tree using in-order & pre-order sequences , in-order & post-order sequence. Expression Tree, Construction of expression tree using stack. Binary Search Trees: Algorithm for construction, searching and insertion operation, Introduction to Height Balanced trees, Balance factor, Balancing the BST by rotations during insertions of a node.
UNIT- IV **(11 Hours)** Heaps: Introduction to binary heaps, definition of a Max-heap, Min-heap, creating Max-Heap Tree using insertion, Graphs: Terminologies, Memory Graph representation - Adjacency matrix, Incidence Matrix, Linked Representation, path matrix, Warshall's Algorithm to find path matrix, Graph Traversals (BFS & DFS), Topological Sorting Hashing: Hashing Functions: Division, Mid-square, Folding methods. Collision, linear probing, chaining
Teaching Methods: Chalk& Board/ PPT
Text Books: 1. "Fundamental of Data Structure" (Schaums Series) Tata-McGraw-Hill. 2. Pai: "Data Structures & Algorithms; Concepts, Techniques & Algorithms "Tata McGraw Hill. 3. Gilberg and Forouzan: "Data Structure- A Pseudo code approach with C" by Thomson publication
Reference Books: 1. "Fundamentals of data structure in C" Horowitz, Sahani & Freed, Computer Science Press. 2. "Data Structures and algorithms" by Narasimha Karumanchi, CareerMonk Publications 3. "Data structures through C in depth" by S.K.Srivastava, BPB Publications

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Subject Code	Name of the Subject	L	T	P	C	
BESBS2140	**DATA STRUCTURE AND ALGORITHMS LABORATORY**	0	0	4	2	

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the concepts of algorithms and implement in developing the programs for different operations of 1D array
CO2	Develop programs for performing different operations on matrix, analyze the them and understand their applications.
CO3	Design code for stack and queue operations and analyze their performance.
CO4	Develop the codes for different operations on linked list, implement concepts or stack and queue using linked list and compare them.

CO-PO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	3												
CO2	2	3	3												
CO3	3	2	2												
CO4	2	2	1												
Avg.	2.25	2.25	2.25												

SYLLABUS

Experiment-1(functions)
Q1) Write a program to create methods for performing addition, subtraction, multiplication and division on 2 integers.

Experiment 2: (concepts of array)
Q1) Write a C program to create methods for operations insertion, deletion, searching and display on 1D array of elements.

Experiment 3:(matrix)
Q1) Write a C program to create function for performing matrix multiplication.

Experiment-4: (pointer and DMA)
Q1) Write a program to store N numbers using dynamic memory allocation and then find the largest element using UDF.

Experiment 5:(structure and DMA)
Q1) Write a C program to create a structure called student to store your rollno, name, age. Create an array to input 5 students data and then create an UDF to display details where age>=20.

Experiment 6: (stack)
Q1) Write a program using C++ to create a stack and perform:
(i) push operation (ii) pop operation (iii) display operation

Experiment 7: (linear queue) Q1) Write a C program to create a linear queue and perform the following operations: (i) insertion ii) deletion and iii) Traversal
Experiment 8: (circular queue) Q1) Write a C program to create a circular queue and perform the following operations: (i) insertion ii) deletion and iii) Traversal
Experiment 9: (sorting) Q1) Write a program to implement bubble sort and selection sort on a list of array elements
Experiment 10: (sorting) Q1) Write a program to implement linear and binary search on array elements using UDF
Experiment 11: (sorting) Q1) Write a program to implement insertion sort on a given list of array elements.
Experiment 12: (sorting) Q1) Write a C program to implement quick sort to a given list of integers to sort in ascending order.
Experiment 13: (single linked list) Q1) Write a C program that uses functions to perform the following operations on single linked list: i) Insertion at beginning, ii) insertion at end, iii) insertion at node item, iv) Deletion of 1st node, v) deletion of last node, vi) deletion of a given node item, vii) search for a node item, iv) display all nodes
Experiment 14: (linked stack) Q1) Write a C program that uses functions to implement linked stack on single linked list.
Experiment 15: (linked queue) Q1) Write a C program that uses functions to implement linked queue on single linked list.

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III Semester [Second Year]

Subject Code	Name of the Subject	L	T	P	C	QP
	DATABASE MANAGEMENT SYSTEM	**3**	**0**	**0**	**3**	**A**

Course Educational Objectives

Pre -Requisite: A student should have basic idea on programming and file systems.

CEO 1	Gain a good understanding of the architecture and functioning of Database Management Systems as well as associated tools and techniques.
CEO 2	Understand and apply the principles of data modeling using Entity Relationship and develop a good database design.
CEO3	Understand the use of Structured Query Language (SQL) and its syntax
CEO4	Apply Normalization techniques for effective database design.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	***Identify*** and ***Classify*** the concepts of Database Management system, Data models and architecture of database, ER to Relational mapping concepts.
CO2	***Applying*** The constraints in database using different query languages like:- relational algebra and calculus, SQL and QBE for ***implementing*** the Data definition and data manipulate languages in Database.
CO3	***Compare*** the different normal forms to ***Apply*** normalization process to construct consistent Database.
CO4	***Design and Develop*** the Database with concurrency control and recovery strategies to make complete Database without confliction and anomalies in concurrent access environment.

CO-PO & PSO Mapping:

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1												
CO2	3	2	1												
CO3	2	1	1												
CO4	2	1	2												
Avg.															

SYLLABUS

UNIT:1 **(15 Hours)**

Introduction to database Systems, advantages of database system over traditional file system, Basic concepts & Definitions, Database users, Database Language, Database System Architecture, Schemas, Sub Schemas, & Instances, database constraints, 3-level database architecture, Data Abstraction, Data Independence, Mappings, Structure, Components & functions of DBMS, Data models.

UNIT:2 **(13 Hours)**

Entity relationship model, Components of ER model, Mapping E-R model to Relational schema, Relational Algebra, Tuple & Domain Relational Calculus, Relational Query Languages: SQL

and QBE. Database Design:-Database development life cycle (DDLC), Automated design tools, Functional dependency and Decomposition, Join strategies, Dependency Preservation & lossless Design, Normalization, Normal forms:1NF, 2NF,3NF, and BCNF, Multi-valued Dependencies, 4NF & 5NF. Query processing and optimization: Evaluation of Relational Algebra Expressions, Query optimization, Query cost estimation.

UNIT:3 **(10 Hours)**

Network and Object Oriented Data models, Storage Strategies: Detailed Storage Architecture, Storing Data, Magnetic Disk, RAID, Other Disks, Magnetic Tape, Storage Access, File & Record Organization, File Organizations & Indexes, Order Indices, B+ Tree Index Files, Hashing Data Dictionary.

UNIT:4 **(12 Hours)**

Transaction processing and concurrency control: Transaction concepts, properties of transaction, concurrency control, locking and Timestamp methods for concurrency control schemes. Database Recovery System, Types of Data Base failure & Types of Database Recovery, Recovery techniques, fundamental concepts on Object-Oriented Database, Object relational database, distributed database, Parallel Database, introduction to Data warehousing & Data Mining.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. *Sudarshan, Korth: Database System Concepts, 6th edition, McGraw-Hill Education*
2. *Elmasari&Navathe: Fundamentals of Database System, Pearson Education.*

Reference Books:

1. *Elmasari&Navathe: Fundamentals of Database System, Pearson Education.*
2. *Ramakrishnan: Database Management Systems, McGraw-Hill Education.*
3. *Andrew S. Tanenbaum: Modern Operating Systems, 3rd Edition, Pearson Education.*
4. *Terry Dawson, Olaf Kirch: Linux Network Administrator's Guide, 3rd Edition O'Reilly*

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Subject Code	Name of the Subject	L	T	P	C	QP
	Operating System	3	0	0	3	A

Course Educational Objectives

CEO1	Provide an insight into the basic organization of computer systems.
CEO2	Familiarize students with various components of an Operating System
CEO3	Focus on fundamental problems and optimal solutions for resource management
CEO4	Understand different possible solutions for handling deadlock situation.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Correlate the different components of an operating system and analyze techniques for system resource management.
CO2	Compare and contrast various scheduling algorithms and their performance tradeoffs.
CO3	Analyze algorithmic solutions for process synchronization problems and handling deadlocks.
CO4	Analyze performance issues associated with I/O devices.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2													
CO2	2	2													
CO3	1	3													
CO4	1	1													
Avg.															

SYLLABUS

UNIT:1 **(10 Hours)**

Operating System Introduction: Operating Systems Objectives and functions, Computer System Architecture, OS Structure, OS Operations, Evolution of Operating Systems - Simple Batch, Multi programmed, time shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, Special - Purpose Systems, Operating System services, user OS Interface, System Calls, Types of System Calls, System Programs, Opening System Design and Implementation, OS Structure, Virtual machines.

UNIT:2 **(12 Hours)**

Process and CPU Scheduling - Process concepts - The Process, Process State, Process Control Block, Threads, Process Scheduling - Scheduling Queues, Schedulers, Context Switch, Pre-emptive Scheduling, Dispatcher, Scheduling Criteria, Scheduling algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Thread scheduling, Case studies: Linux, Windows. Process Coordination - Process Synchronization, The Critical section Problem, Peterson's solution, Synchronization Hardware, Semaphores, and Classic Problems

of Synchronization, Monitors, Case Studies: Linux, Windows.

UNIT:3 **(14 Hours)**

Memory Management and Virtual Memory - Logical & physical Address Space, Swapping, Contiguous Allocation, Paging, Structure of Page Table. Segmentation, Segmentation with Paging, Virtual Memory, Demand Paging, Performance of Demanding Paging, Page Replacement Algorithms, Allocation of Frames, Thrashing.

Deadlocks - System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery from Deadlock.

UNIT:4 **(14 Hours)**

File System Interface - The Concept of a File, Access methods, Directory Structure, File System Mounting, File Sharing, Protection, File System Implementation - File System Structure, File System Implementation, Allocation methods, Free-space Management, Directory Implementation, Efficiency and Performance. Mass Storage Structure - Overview of Mass Storage Structure, Disk Structure, Disk Scheduling, Disk Management, Swap space Management.

Protection - System Protection, Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems, Language-Based Protection.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books/References:

1. *Operating System Principles, Abraham Silberchatz, Peter B. Galvin, Greg Gagne 8th Edition, Wiley Student Edition.*
2. *Operating systems - Internals and Design Principles, W. Stallings, 6th Edition, Pearson.M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.*
3. *Modern Operating Systems, Andrew S Tanenbaum 3rd Edition PHI.*
4. *Operating Systems A concept - based Approach, 2nd Edition, D. M. Dhamdhere, and TMH.*
5. *Principles of Operating Systems, B. L. Stuart, Cengage learning, India Edition.*
6. *Operating Systems, A. S. Godbole, 2nd Edition, TMH*
7. *An Introduction to Operating Systems, P.C.P. Bhatt, PHI.*
8. *Operating Systems, S, Haldar and A. A. Arvind, Pearson Education.*
9. *Operating Systems, R. Elmasri, A. G. Carrick and D. Levine, McGraw Hill.*
10. *Operating Systems in depth, T. W. Doeppner, Wiley.*

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Subject Code	Name of the Subject	L	T	P	C	QP
	OBJECT ORIENTED PROGRAMMING THROUGH JAVA	**3**	**0**	**0**	**3**	**A**

Course Educational Objectives

CEO1	The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism
CEO2	Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
CEO3	How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.
CEO4	How to test, document and prepare a professional looking package for each business project using java doc.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Analyze ,formulate and model problems using concepts of object oriented analysis and design and implement using Java.
CO2	Write programs using basic data types and strings, using loops, Array.
CO3	Analyze the problems and resolve run-time errors with Multithreading and Exception Handling techniques
CO4	Understand the power of generics and Collections Framework and Java.io package

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1											1		
CO2	3	2	2										1		
CO3	2	2	2										2		
CO4	2	1	2										1		
Avg.													1		

SYLLABUS

Unit – I **[12Hrs]**

An introduction to Object Oriented Programming, Features of Object Oriented Programming Introduction to Java. Difference between C/C++ and Java, Features of Java, First Java Program, Writing the java program, Compiling the program, JVM and its significance in executing a program, Architecture of JVM. Understanding, Java Tokens, Datatypes, Operators, Control Structures and Arrays, Conditional Statements, Loops/ Iterators, Jumping Statements, Java Arrays, Multidimensional Arrays, Taking Input from keyboard, Command Line Arguments, Using Scanner Class, Using Buffered Reader class.

Unit - II **[12Hrs]**

Introduction to Classes and Objects. Constructors, static Keyword, this Keyword, Array of Objects, Access Modifiers (Public, Private, Protected, Default). Inheritance, Types of Inheritance and Java supported Inheritance, super, Polymorphism, Method Overloading, Constructor Overloading, Method Overriding, Dynamic Method Dispatching. String Manipulations. Wrapper classes, Auto boxing and unboxing. Abstract classes, Interfaces, Multiple Inheritance Using Interfaces,

Java API Packages, User-Defined Packages, Accessing Packages, Error and Exception Handling, Types of exceptions Hierarchy of Exception classes, try, catch, finally, throw, throws, Commonly used Exceptions and their details ,User defined exception classes.

Unit – III [12 Hrs]

Multithreading, Thread in Java, Thread execution prevention methods. (yield(), join(), sleep()), Concept of Synchronization, Inter Thread Communication, Basics of Deadlock, Demon Thread, Improvement in Multithreading, Inner Classes, Introduction, Member inner class, Static inner class, Local inner class, Anonymous inner class.

IO Streams (java.io package), Byte Stream and Character Stream, Files and Random Access Files, Serialization, Collection Frame Work (java.util), Util Package interfaces, List, Set, Map.

Unit – IV **[12 Hrs.]**

Applet Introduction, Life Cycle of an Applet, GUI with an Applet, Abstract Window Toolkit (AWT), Introduction to GUI, Description of Components and Containers, Component/Container hierarchy, Understanding different Components/Container classes and their constructors, Event Handling, Different mechanisms of Event Handling, Listener Interfaces, Adapter classes.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Book:

1. *Programming in Java. Second Edition. Oxford Higher Education. (SachinMalhotra/ SauravChoudhary)*
2. *Core Java For Beginners. (RashmiKanta Das), Vikas Publication*

Reference Book:

3. *JAVA Complete Reference (9th Edition) HerbaltSchelidt*

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IV Semester [Second Year]

Subject Code	Name of the Subject	L	T	P	C	QP
	Fundamentals of Python Programming	3	1	0	4	A

Course Educational Objectives

CEO1	To understand the basics of programming using Python.
CEO2	To Construct and execute basic programs in Python.
CEO3	To implement database connectivity, CGI, Multithreading and web development in python.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the basic concept of Python like data types and syntax of programming.
CO2	Use python programming with user defined & built-in methods, objects of Python.
CO3	Design application using the concepts of file, database access and exception handling.
CO4	Create practical and contemporary applications such as web applications and discrete-event simulations, data analysis and IoT devices.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES														
	1	2	3	4	5	6	7	8	9	10	11	12			
CO1	3	1			1							1			
CO2	2	3	1	3	2							1			
CO3	2	3	3	3	2				1		1	2			
CO4	2	3	3	3	2				1		1	2			
Avg.	2.25			3					1		1	1.5			

SYLLABUS

UNIT:1 **(08 Hours)**

Introduction: Installation, First Python Program: Interactive Mode Programming, Script Mode Programming; Identifiers, Reserved Words, Lines and Indentation, Multi-Line Statements, Quotation & Comments; Assigning Values to Variables, Multiple Assignment.

Standard Data Types: Numbers, Strings, Lists, Tuples, Dictionary; Data Type Conversion; Basic Operators: Arithmetic, Comparison, Assignment, Bitwise; Operators: Logical, Membership, Identity; Operators Precedence; Python Numbers & Mathematical functions, Python Strings.

UNIT:2 **(10 Hours)**

Python Program Flow Control : Conditional blocks using if, else and elif, Simple for loops in

python, For loop using ranges, string, list and dictionaries, Use of while loops in python, Loop manipulation using pass, continue, break and else, Programming using Python conditional and loops block

Python Functions, Modules And Packages: Organizing python codes using functions, Organizing python projects into modules, Importing own module as well as external modules, Understanding Packages, Powerful Lamda function in python, Programming using functions, modules and external packages

Python String, List And Dictionary Manipulations : Building blocks of python programs, Understanding string in-built methods, List manipulation using in-built methods, Dictionary manipulation, Programming using string, list and dictionary in build functions

UNIT:3 **(12 Hours)**

Python File Operation : Reading config files in python, Writing log files in python , Manipulating file pointer using seek, Programming using file operations, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines()

Python Object Oriented Programming – OOPS: Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance , overlapping and overloading operators, Adding and retrieving dynamic attributes of classes , Programming using Oops support

Python Regular Expression : Powerful pattern matching and searching, Power of pattern searching using regex in python, Real time parsing of networking or system data using regex, Password, email, url validation using regular expression, Pattern finding programs using regular expression

Python Exception Handling : Avoiding code break using exception handling, Safe guarding file operation using exception handling, Handling and helping developer with error code, Programming using Exception handling

UNIT:4 **(15 Hours)**

Python Database Interaction: SQL Database connection using python, Creating and searching tables, Reading and storing config information on database, Programming using database connections

Python Multithreading: Understanding threads, forking threads, Synchronizing the threads, Programming using multithreading

Python CGI Introduction : Writing python program for CGI application, Creating menus and accessing files, Server client program

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. "Python: The Complete Reference",Martin C. Brown, McGraw-Hill/Osborne Media.
2. "Learning Python", Mark Lutz, O'Reilly Media, Inc., Fifth Edition, 2013.

Reference Books:

1. "Expert Python Programming", Tarek Ziad, Packt Publishing.
2. "Python Essential Reference, David Beazley", Dveloper's Library, Sams Publishing.

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Subject Code	Name of the Subject	L	T	P	C	QP
	Computer Organization and Architecture	**3**	**0**	**0**	**3**	**A**

Course Educational Objectives

CEO1	Identify the functional units in a digital computer system,
CEO2	Distinguish between the various ISA styles and trace the execution sequence of an instruction through the processor.
CEO3	Compare different approaches used for implementing a functional unit and evaluate different computer systems based on performance metrics.
CEO4	Provide an outline of working principles of components of computer.

Course Outcomes: : *Upon successful completion of this course, students should be able to:*

CO1	***Explain*** and ***illustrate*** the execution cycle of a program.
CO2	***Classify*** the components of digital computer and ***designing*** of control and memory units with performance ***evaluation***.
CO3	***Compute*** different types of binary arithmetic operation. .
CO4	***Identify*** the characteristics of memories and ***explain*** memory and IO devices working process.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1													
CO2	3	2	1												
CO3	1	3	2	1											
CO4	1	1	3	2											
Avg.															

SYLLABUS

UNIT:1 **(12 Hours)**

FUNDAMENTALS OF A COMPUTER SYSTEM: Functional Units of a Digital Computer ,Hardware ,Software Interface, Translation from a High Level Language to the Hardware Language Instruction Set Architecture, Styles and features, RISC and CISC Architectures ,Performance Metrics ,Amdahl's Law ,Case Studies of ISA.

UNIT:2 **(12 Hours)**

BASIC PROCESSING UNIT: Components of the Processor, Data path and Control – Execution of a Complete Instruction, Hardwired and Micro programmed Control, Instruction

Level Parallelism, Basic Concepts of Pipelining, Pipelined Implementation of Data path and Control, Hazards, Structural, Data and Control Hazards ,Exception handling. Parallelism and Multiprocessor Architecture, Flynn's Classification, UMA, NUMA, Distributed Memory Architecture. Array and Vector Processor.

UNIT:3 **(12 Hours)**

ARITHMETIC FOR COMPUTERS: Addition and Subtraction, Fast Adders, Binary Multiplication, Fast Multiplication, Binary Division and its techniques, Floating Point Numbers, Representation, Arithmetic Operations.

UNIT:4 **(12 Hours)**

MEMORY AND I/O : Need for a hierarchical memory system, Types and characteristics of memories ,Memory location and address, Endianness of memory representation, Cache memories, Improving cache performance, Virtual memory ,Memory management techniques, cache mapping and its techniques ,Associative memories. Page Replacement Algorithms. Accessing I/O devices – Programmed Input/output, Interrupts, Direct Memory Access ,Interface circuits ,Need for Standard I/O Interfaces like PCI, SCSI, USB.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. *Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw Hill, 2012.*
2. *David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Fourth Edition, Morgan Kaufmann / Elsevier, 2009.*
3. *Kai Hwang and F.A. Briggs, "Computer Architecture and Parallel Processing", McGraw Hill.*

Reference Books:

4. *M. Morris Mano, "Computer System Architecture", PHI*
5. *William Stallings, "Computer Organization and Architecture – Designing for Performance", Sixth Edition, Pearson Education, 2003.*
6. *John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata McGraw Hill, 1998.*
7. *John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.*

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Subject Code	Name of the Subject	L	T	P	C	QP
BCSPC3020	**DESIGN AND ANALYSIS OF ALGORITHMS**	3	1	0	4	A

Course Educational Objectives

CEO1	Analyze the asymptotic performance of algorithms
CEO2	Demonstrate familiarity with major algorithms
CEO3	Apply important algorithmic design paradigms and methods of analysis
CEO4	Synthesize efficient algorithms in common engineering design situations

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Analyze worst-case running times of algorithms using asymptotic analysis
CO2	Apply the algorithms and design techniques to solve problems.
CO3	Apply the algorithms and design techniques to find the optimal solution.
CO4	Apply the approximation algorithm for time consuming problem.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	1												
CO2	1	1	1												
CO3	2	3	3												
CO4		1	2	1											
Avg.															

SYLLABUS

Unit – I **[15Hrs]**

Introduction:

Definition, Characteristics of algorithm, Growth of Functions, Asymptotic analysis, Amortized analysis, standard notations and common functions, limit theorem, String's formula. Recurrences: solution of recurrences by substitution, recursion tree and Master methods, Extension Master Methods. Algorithm design techniques.

Unit - II **[15Hrs]**

Divide-and- conquer Approach: Binary search, Quick sort, Merge sort, Heap Sort, Priority Queue, Lower bounds for sorting. Worst case analysis of Quick sort.

Dynamic programming methodology: Elements of dynamic programming, Matrix-chain multiplication, Longest common subsequence, Assembly-line scheduling.

Greedy Algorithms: Elements of Greedy strategy, Activity selection Problem, Fractional knapsack problem, Huffman codes.

Unit – III **[10Hrs]**

Graph Algorithms: Data structure for disjoint sets, Disjoint set operations, Linked list representation, path compression, Disjoint set forests. Graph Algorithms and their characteristics, Breadth first search and depth-first search, Minimum Spanning Trees, Kruskal algorithm and Prim's algorithms, single- source shortest paths (Bellman-ford Algorithm and Dijkstra's algorithms), All-pairs shortest paths (Floyd–Warshall Algorithm).

Unit – IV **[10 Hrs]**

Back tracking, Branch and Bound, Eight Queen problem, Sub Set Sum Problem. String matching algorithms, naïve string matching algorithm, Rabin-Karp algorithm, Knuth–Morris–Pratt algorithm, NP - Completeness (Polynomial time, Polynomial time verification, NP - Completeness and reducibility, NP-Complete problems (without Proofs), Approximation algorithms characteristics, Traveling Salesman Problem, vertex Cover Problem.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Book:

1. Introduction to Algorithms, T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein, 2nd Edition, PHI Learning Pvt. Ltd.

2. Fundamentals of Algorithm, Horowitz &Sahani:, 2nd Edition, Universities Press.

Reference Book:

1. Algorithms, Design and Analysis, H. Bhasin, First Edition, Oxford University

2. Design and Analysis of Algorithm, S. Sridhar, Oxford University Press

3. Algorithms, Sanjay Dasgupta, UmeshVazirani , McGraw-Hill Education.

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Subject Code	Subject Code	L	T	P	C	QP
	Computer Networks	**3**	**0**	**0**	**3**	**A**

Course Educational Objectives	
CEO1	To discuss the digital data communication techniques
CEO2	Gain knowledge on basic concepts of data communication layers, protocols and performance
CEO3	Understand a few representative protocols and network components
CEO4	To introduce the functions of different layers from deployed examples
Course Outcomes: : *Upon successful completion of this course, students should be able to:*	
CO1	Understand the basic concepts on data communication layers, protocols and performance
CO2	Describe the hardware and software commonly used in data communications
CO3	Analyse the services and features of various layers of data networks
CO4	Design, implement and analyze simple networks that need data communication.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1													
CO2	3	1													
CO3	2	2													
CO4	2	3		1											
Avg.															

SYLLABUS

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UNIT:1 **(12 Hours)**

Overview of Data Communications and Networking.

Networks models – TCP/IP Protocol Suite , OSI model – Layers in OSI Digital Transmission: Line coding, Block coding, Sampling, Transmission mode. Analog Transmission: Modulation of Digital and Analog Data; Transmission Media: Guided Media, Unguided media (wireless) Circuit switching: Circuit switching (Data gram Networks and Virtual circuit networks)

UNIT:2 **(12 Hours)**

Data Link Layer

Error Detection and correction: Types of Errors, Detection, Error Correction Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Go-Back-N ARQ, Selective Repeat ARQ, HDLC. Point-to –Point Access: PPP Point –to- Point Protocol, PPP Stack, Multiple Access Random Access, Controlled Access, Channelization.

UNIT:3 **(10 Hours)**

Local area Network: Ethernet. Traditional Ethernet, Fast Ethernet, Gigabit Ethernet. Token bus, token ring Wireless LANs: IEEE 802.11, Bluetooth virtual circuits: Frame Relay and ATM.

Network Layer:

Host to Host Delivery: Internetworking, addressing and Routing Network Layer Protocols: ARP, IPV4, ICMP, IPV6 ad ICMPV6

UNIT:4 **(10 Hours)**

Transport Layer: Process to Process Delivery: UDP; TCP congestion control and Quality of service. **Application Layer :**Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP) and file transfer (FTP) HTTP and WWW.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Book:

1. *Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.*
2. *Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.*

Reference Book:

1. *Computer Networks: A system Approach: Larry L, Peterson and Bruce S. Davie, Elsevier, 4th Ed*
2. *Computer Networks: Natalia Olifer, Victor Olifer, Willey India*
3. *Data and Computer Communications: William Stallings, Prentice Hall, Imprint of Pearson, 9th Ed. 4. Data communication & Computer Networks: Gupta, Prentice Hall of India Network for Computer Scientists & Engineers: Zheng, Oxford University Press*

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Subject Code	Name of the Subject	L	T	P	C	QP
	Formal Language & Automata Theory	**3**	**1**	**0**	**4**	A

Course Educational Objectives

CEO1	To familiarize students to construct regular expressions, regular grammars & to identify non - regular languages
CEO2	Teach students to identify context - free languages, to convert the given grammar to various normal forms, & to make use of membership algorithm.
CEO3	Teach students to construct Push - Down Automata which represent context - free languages, closure properties, & to identify non - context - free languages.
CEO4	To familiarize students to Recursively Enumerable languages, Recursive languages, construction of Turing Machines, PCP, & un decidable problems.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Explain the basic concepts of formal computation and its relationship to language.
CO2	Classify language into their types and derive its equivalent regular expression.
CO3	Apply formal reasoning to construct different language and grammar set.
CO4	Analyze complexity of various problem solving techniques using PDA and TM with recursion.

CO-PO & PSO Mapping

Cos	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1													
CO2	3	2													
CO3	2	3	2												
CO4	2	3													
Avg.															

SYLLABUS

UNIT:1 **(12 Hours)**

Mathematical preliminaries: Alphabet, String, Languages, Grammars, Strings and operations on strings.

Finite Automata: Definition, Basic model, Types of Finite Automata, Design of DFA, Design of NFA, NFA vs. DFA, Eliminating **ε**-transitions from NFA, NFA to DFA conversion, NFA or DFA as a language acceptor, Minimization of Finite Automata. Equivalence of two Finite Automata

UNIT:2 **(14 Hours)**

Regular Expressions: Regular Set and Regular Expressions. Operators in Regular expressions, Building Finite Automata from Regular expression, Arden's theorem & Building Regular expression from Finite Automata, Pumping Lemma for Regular languages, Closure properties of Regular languages.

Grammar: Definition, Regular Grammar, Regular Grammar to Finite Automaton, Finite Automaton to Regular Grammar, Designing Context Free Grammar, String Derivation, Parse Tree Construction, Ambiguous Grammar, Chomsky and Greibach Normal Forms, CYK parsing algorithm,Closure

Properties of CFL, Pumping Lemma for CFL, Introducing Non-Context Free Grammar, Chomsky Hierarchy.

UNIT:3 **(12 Hours)**

Push Down Automata: Basic Model, Components, Moves of a PDA, ID of a PDA, Design of Deterministic PDA and Non-deterministic PDA, PDA to CFG and CGA to PDA conversion.

Turing Machines: Basic Model, Components, move of a TM, ID of TM, Design of a TM, Variants Of Turing Machine, Recursively Enumerable Languages, Undecidable problems, Post correspondence problem as an Undecidable Problem. Linear Bounded Automata and Context Sensitive Languages

UNIT:4 **(10 Hours)**

Primitive Recursive functions: μ- Recursive functions, Cantor and Godel numbering, ckermann's function, Excursiveness of Ackermann and Turing computable functions. Church Turing hypothesis, Recursive and Recursively Enumerable sets, NP Completeness: P and NP, NP complete and NP Hard problems.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Book:

1. Introduction to the theory of computation, Michael Sipser, Cengage Learning.
2. Formal Language and Automata Theory, C. K. Nagpal, Oxford University Press.

Reference Books:

3. Theory of Computer Science : Automata, Languages And Computation by by*K L P Mishra* and N Chandrasekaran
4. Introduction to Automata Theory, Languages and Computation: J. E. Hopcroft, J.D Ullman, Pearson Education.

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