

Course Title	Discrete Mathematics and Graph Theory	Slot	D2+TD2+TDD2
		Class Nbr	CH2024250102101
Time	3 hours	Max. Marks	100

General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

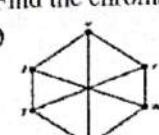
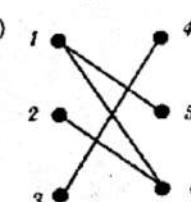
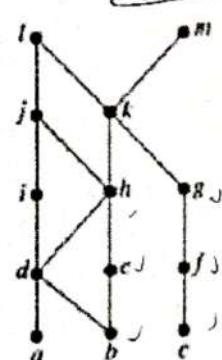
Course Outcomes

1. Learn proof techniques and concepts of inference theory
2. Use algebraic structures in applications
3. Counting techniques in engineering problems.
4. Use lattice and Boolean algebra properties in Digital circuits.
5. Solve Science and Engineering problems using Graph theory.

Section - I Answer any 10 Questions (10 × 10 Marks)

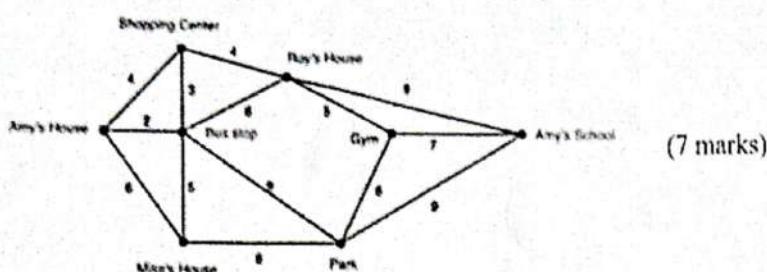
*M - Marks

Q.No	Question	*M	CO	BL
01.	<p>(a) Using rules of inference show that the following hypotheses “If it does not rain or if it is not foggy, then the sailing race will be held and the lifesaving demonstration will go on”, “If the sailing race is held, then the trophy will be awarded” and “The trophy was not awarded” imply the conclusion “It rained”.</p> <p>(b) Using the rules of inference show that $\neg p \wedge \neg q \Rightarrow \neg(p \wedge q)$. [7+3 marks]</p>	10	1	3
02.	<p>(a) Prove the following by proving the equivalences of the duals: $(p \vee q) \rightarrow r \equiv (p \rightarrow r) \wedge (q \rightarrow r)$ (5 marks)</p> <p>(b) Without constructing the truth tables, prove the $((p \vee q) \wedge \neg(\neg p \wedge (\neg q \vee \neg r))) \vee (\neg p \wedge \neg q) \vee (\neg p \wedge \neg r)$ is a tautology. (5 marks)</p>	10	1	2
03.	<p>(a) Given the generator matrix</p> $G = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$ <p>corresponding to the encoding function $e : B^4 \rightarrow B^7$, find the corresponding parity check matrix and use it to decode the following received words and hence find the original message: <u>1100011</u>, <u>1110111</u>, <u>0011001</u>, <u>1011100</u>. (5 marks)</p> <p>(b) If M_2 is the set of 2×2 non-singular matrices over R and $T = \left\{ \begin{bmatrix} 1 & b \\ 0 & 1 \end{bmatrix} : b \in R \right\}$, Show that T is a subgroup of M_2 under matrix multiplication. Also, check if T is abelian or not.</p>	10	2	2

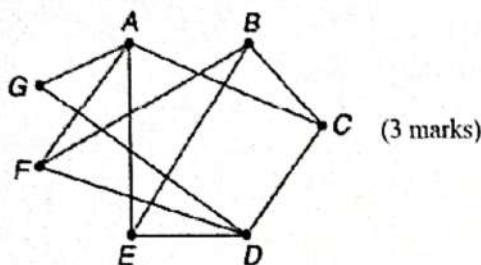
			10 3,5 2
04.	<p>(a) (i) How many ways the word 'ASSASSINATION' can be written? (5 marks)</p> <p>ii) In a small village, there are 87 families, of which 52 families have at most 2 children. In a rural development programme, 20 families are to be chosen for assistance, of which at least 18 families must have at most 2 children. In how many ways can the choice be made? [5 marks]</p> <p>(b) Find the chromatic number of the following graphs:</p> <p>a) </p> <p>b) </p> <p>[5 marks] </p>		
05.	<p>a) Find a recurrence relation and initial conditions for $1, 5, 17, 53, 161, 485, \dots$ (3 marks)</p> <p>b) Use generating functions to solve the recurrence relation $a_n = a_{n-1} + 4^{n-1}$ with the initial condition $a_0 = 1$ and $n \geq 1$ (7 marks)</p>	10 3 2	
06.	<p>Answer these questions for the partial order represented by this Hasse diagram. </p> 	10 4 2	
07.	<p>a) Determine whether the relation R on the set of all integers is reflexive, symmetric, anti-symmetric, and/or transitive, where aRb iff (i) $a \neq b$ (ii) $ab \geq 0$. (5 marks)</p> <p>b) (i) Show that the group $\{(1, 2, 4, 5, 7, 8), \times_9\}$ is cyclic. What are the generators? (2.5 marks)</p> <p>(ii) Suppose that K is a proper subgroup of H and H is a proper subgroup of G. If $K =42$ and $G =420$, what are the possible orders of H. (2.5 marks)</p>	10 2,4 2	

08. (a) The following graph illustrates the distance between two places in the area, with the weights on the edges corresponding to the distance between the places. Find the shortest route along with the total distance between Amy's house and all other places in the area.

10 5 2

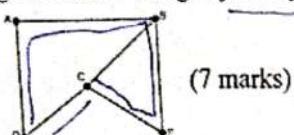


- (b) Check if given following graph is bipartite or not? Explain.



09. (a) (i) Find the number of walks of length 4 from the vertex A to E in the undirected graph given below using adjacency matrix and identify those walks from the graph.

10 5 3



Also find a Hamiltonian path or a Hamiltonian circuit for this graph, if it exists.

- (b) Is it possible to draw a graph with vertices of degrees (7, 6, 5, 4, 4, 3, 2, 1). Else explain, why it is not possible. (3 Marks)

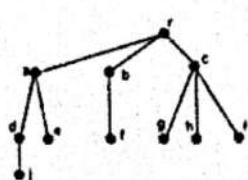
10. (a) Consider the table of airline distances in miles between six of the largest cities in the world, London, Mexico, New York, Paris, Pecking, and Tokyo:

10 5 3

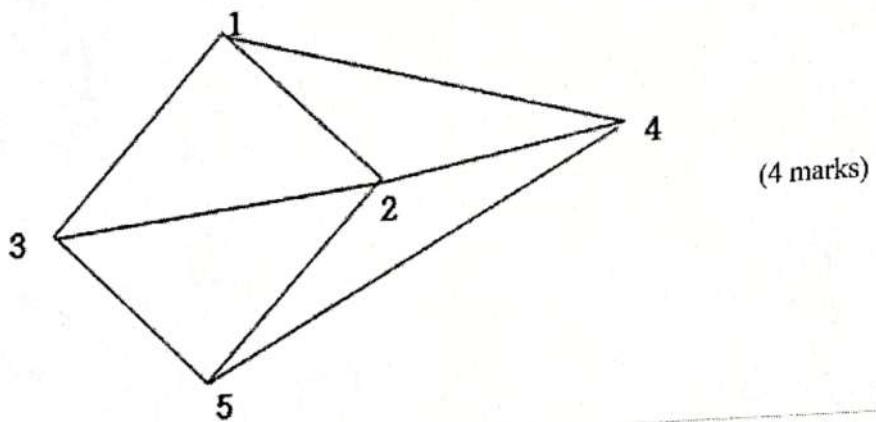
..	L	MC	NY	Pa	Pe	T
L	5558	3469	214	5074	5959	
MC	5558	2090	5725	7753	7035	
NY	3469	2090	3636	6844	6757	
Pa	214	5725	3636	5120	6053	
Pe	5074	7753	6844	5120	1397	
T	5959	7035	6757	6053	1397	

Construct the weighted graph and also find the minimum spanning tree using Prim's algorithm. (7 marks)

- (b) Find the eccentricity of all the vertices. Also find the Centre, Diameter, and Radius of the following tree: (3 marks)



			10 5 2
11.	Construct the rooted tree whose preorder traversal is a,b,f,c,g,h,i,d,e,j,k,l where a has 4 children, c has 3 children, j has 2 children, b and e have one child each and all other vertices are leaves. Find the in-order and post-order traversals of the tree. [10 Marks]		
12.	<p>(a) A university campus is organizing a cultural festival where different zones are set up for various activities. The zones are named as follows: Zone X (Food Court), Zone Y (Sports Activities), Zone Z (Live Performances), and Zone W (Art Exhibitions). The zones are arranged in such a way that Zone X is adjacent to Zone Y and Zone Z, Zone Y is adjacent to Zone X and Zone W, Zone Z is adjacent to Zone X and Zone W, and Zone W is adjacent to Zone Y and Zone Z. The organizers want to assign different colors to each zone so that no adjacent zones share the same color.</p> <p>(i) Construct the graph representing the zones and their adjacency relationships. (2 marks)</p> <p>(ii) Determine the minimum number of colors required to color the zones under this condition. Justify your answer. (2 marks)</p> <p>(iii) Name and explain the theorem that guarantees the zones can be colored this way. (2 marks)</p> <p>(b) Find the chromatic polynomial of the following graph</p>	10 5 3	



BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)





Final Assessment Test(FAT) - Apr/May 2025

Programme	B.Tech.	Semester	Winter Semester 2024-25
Course Code	BCSE303L	Faculty Name	Prof. Nivethitha V
Course Title	Operating Systems	Slot	D2+TD2
		Class Nbr	CH2024250502277
Time	3 hours	Max. Marks	100

Instructions To Candidates

- Write only your registration number in the designated box on the question paper. Writing anything elsewhere on the question paper will be considered a violation.

Course Outcomes

On completion of this course, student should be able to:

- CO1: Interpret the evolution of OS functionality, structures, layers and apply various types of system calls of various process states.
 CO2: Design scheduling algorithms to compute and compare various scheduling criteria.
 CO3: Apply and analyze communication between inter process and synchronization techniques.
 CO4: Implement page replacement algorithms, memory management problems and segmentation.
 CO5: Differentiate the file systems for applying different allocation, access technique, representing virtualization and providing protection and security to OS..

Section - I**Answer all Questions (7 × 10 Marks)**

01. An organization is working on a real-time drone control system that assures minimal latency in network communication, process sensor inputs, and run control algorithms. The system should be able to withstand failures in non-essential services (such as logging, user interface, and telemetry) without affecting essential elements like navigation and obstacle avoidance. The developers are arguing over the best way to structure the OS.

- a) Discuss the pros and cons of implementing various OS structuring methods in context of the given scenario. [5 marks]
 b) Recommend a suitable OS structure for the drone control system justifying your choice based on the requirements of the company. [5 marks]

[10] (CO1/K2)

02. Two separate weather stations provide temperature data to a weather monitoring system, which must process the data effectively using parallel processing. Each of the two child processes that the system generates should be in charge of processing "n" temperature readings from an array (for example, 30, 32, 31, 29, 28 for a single station). The average temperature of each array should be determined by each child, who should then display the result and its process ID. After all child processes have completed their execution, the parent process should show "All weather stations processed. Data analysis is finished."

- a) Write a C program to implement this using necessary system calls [5 marks]
 b) Draw the Process Control Block (PCB) for the parent and child processes. Also, illustrate the process state transition diagram, showing the transitions between process states for both the parent and child processes. [5 Marks]

[10] (CO1/K3)

03. A hospital's emergency department must efficiently allocate doctors' time to treat incoming patients based on their arrival time, required treatment duration, and urgency. The hospital follows two different scheduling strategies:

- a) The patient requiring the least remaining treatment time is always given preference. [5 marks]
 b) Each patient receives a fixed treatment slot of 3 time units. If multiple patients arrive at the same time, the one with the higher priority is treated first in the initial cycle. However, after receiving their first 3 time units, they are placed at the back of the queue, and further treatment follows the order of the queue, regardless of

priority. [5 marks]

Draw the treatment timeline and calculate the Average Waiting Time and Average Turnaround Time for each strategy. Finally, analyze the results to decide which strategy works better. The patient details are given below:

Patient ID	Arrival Time	Required Treatment time	Priority
P1	0	12	3
P2	2	6	1
P3	4	14	5
P4	6	8	2
P5	8	10	4
P6	10	5	1
P7	12	7	2

[10] (CO2/K3)

04. A multi-user workflow system is used in an organization where employees submit requests for performing certain high-priority tasks. Each request must be processed in a fair manner, ensuring that no employee is given unfair priority over others. Every employee submits a request before proceeding with the task. Each request is assigned a unique number based on an ascending ordering mechanism. Employees must wait for their turn to ensure an orderly execution of requests. Once a request is processed, the assigned number is reset, allowing others to proceed with their tasks. The system must prevent any request from waiting indefinitely.
- In order to handle client requests effectively, fairly, and without causing disputes, suggest a solution. And also the pseudocode for the system's request assignment and processing should be written. [8 Marks]
 - In this system, if two employees receive the same request number, how should the system determine which request to process first? Justify your answer. [2 Marks]

[10] (CO3/K3)

05. One barber and a small number of waiting seats are all that are present in a barbershop. Clients show up at random times. They sit down and wait for the barber if there is a chair available. The client leaves before receiving a haircut if every chair is taken. One client at a time is served by the barber, who takes a nap while no one is waiting. The barber never trims more than one customer's hair at once, customers wait if the barber is busy, and the barber sleeps when no customers are waiting. This is achieved by writing pseudocode using two semaphores to establish correct synchronization. Avert starvation and deadlock using your answer. Make changes to your solution to accommodate VIP clients, who are given precedence over ordinary clients. Make sure that normal clients are not starved indefinitely by VIP patrons.

[10] (CO3/K3)

06. A university computing lab manages access to 5 shared computational resources (R1, R2, R3, R4, R5) for 4 research teams (A, B, C, D). Each team has been allocated some resources, but they also have additional maximum resource requirements to complete their experiments.

The current resource allocation and maximum need are as follows:

Teams	Allocated					Maximum				
	R1	R2	R3	R4	R5	R1	R2	R3	R4	R5
A	1	0	2	1	1	1	2	1	3	3
B	2	0	1	1	0	2	2	2	1	0
C	1	1	0	1	1	3	1	3	1	1
D	1	1	1	1	0	1	2	2	2	0

If available Resources are: //

R1	R2	R3	R4	R5
0	0	X	1	1

Determine the smallest value of X for which the system remains in a safe state. [6 Marks]

Find the safe sequence for resource allocation when X is at its smallest possible value. [2 Marks]

Suggest a deadlock recovery strategy in case a deadlock occurs. [2 Marks]

[10] (CO2/K3)

07. a. Imagine that there are 15 free blocks on the disk among 50 blocks, each of size 512 bytes need to be utilized to store a new file named *largefile* that is 4,608 bytes in size. Since the file is larger than a single block, it will need to be spread across multiple blocks. However, the file cannot be stored in a sequence of adjacent blocks. Draw a diagram of the disk showing how the blocks are allocated for the *largefile*. [5 Marks]
- b. Imagine you have a disk with 50 blocks, numbered from 0 to 49, and each block has a size of 512 bytes. Each pointer in the file allocation table takes up 40 bytes. You need to store a file of 7,680 bytes, and there are 25 usable blocks. Calculate how many blocks you would need to store this file, describe a method for organizing these blocks efficiently, and draw a diagram of the disk showing how the blocks are allocated. [5 Marks]

Section - II
Answer all Questions (2 × 15 Marks)

08. a) In a video game, a player's character can interact with several objects, such as weapons (W), enemies (E), items (I), P (Power-ups), T (Traps), H (Health Packs) and checkpoints (C), while exploring different levels. The game has a limited amount of memory to store these objects while navigating through various levels. The character can only interact with 3 objects at a time, and when the memory is full, the game needs to replace an object to load a new one. The objects need to be loaded in the following sequence: W, I, E, H, T, P, C, I, W, T, P, E, H, W, E. The game works based on the following strategies, and your task is to calculate how many misses and hits occur for all strategies, where:

- **Miss:** A new object is loaded and replaces an old one from memory (because the memory is full).
- **Hit:** The object is already in memory, so no replacement is needed.

Strategies:

- The game replaces the object that was last used the furthest back in time across all levels.
- The game replaces the object that will not be used for the longest period of time in the future.
- The game replaces the object that was introduced first in the memory.

Analyse and state which strategy would be better for the given scenario. [10 Marks]

- b) Let the page fault service time be **30ms** in a computer with average memory access time being **25ns**. If one page fault is generated for every **100** memory accesses, what is the Effective Access Time for memory? [2 Marks]

- c) Consider a paging system with a Translation Look aside Buffer (TLB). The TLB hit ratio is **75%**, and it takes **10 nanoseconds** to search the TLB. The memory access time is **200 nanoseconds**. If a page is not found in the TLB, the system must first access the page table in memory before accessing the required page. Calculate the Effective Access Time (EAT) and provide a step-by-step solution. [3 Marks]

[15] (CO4/K3)

09. In a flood-affected area, a food delivery drone is tasked with delivering meals to various locations. Each delivery point is assigned a unique index representing its location, with a total of 5000 delivery points (indexed from 0 to 4999). The drone is currently stationed at delivery point 120. The delivery queue for the morning is as follows: Delivery points: 79, 1301, 772, 55, 1081, 650, 22, 564, 286, and 502.

Starting from the current drone position, what is the total distance (in delivery points) that the drone moves in the morning for each of the following scheduling algorithms?

- a) As the drone heads towards the lower indexed locations first, ensure it services all requests in that direction before reversing its course. (Movement towards lesser value) [5 marks]
- b) The drone begins by addressing the requests in the upward direction from its current location, focusing on the closest points and servicing them without reversing back. (Movement towards higher value) [5 marks]
- c) The drone should service all delivery points in the upward direction, and upon reaching the highest point, it must jump back to the beginning of the list before continuing to address the remaining requests in the same direction. (Movement towards lesser value) [5 marks]

[15] (CO5/K3)

BL-Bloom's Taxonomy Levels - (K1-Remembering,K2-Understanding,K3-Applying,K4-Analysing,K5-Evaluating,K6-Creating)





Final Assessment Test (FAT) - May 2024

Programme	B.Tech.	Semester	WINTER SEMESTER 2023 - 24
Course Title	STRUCTURED AND OBJECT-ORIENTED PROGRAMMING	Course Code	BCSE102L
Faculty Name	Prof. AMUTHAS	Slot	B2
Time	3 Hours	Max. Marks	100
General Instructions:			
<ul style="list-style-type: none"> Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details. 			

Section - I

Answer all questions (2 X 8 Marks = 16 Marks)

01. You are tasked with creating software for a hospital administration system that handles patient records, appointments, and medical inventories. Discuss the significance of storage types in this context, and provide relevant examples from the system. [8]
02. Create a game similar to Hangman in which the player guesses letters in order to mimic a concealed word. Store a two-dimensional array [2 marks] of at least five eight-letter words, and choose one at random to be the secret word. Initially, display the secret word with asterisks replacing each letter. Allow the user to guess letters and replace the asterisks in the hidden word until the user completes the entire word. If the user guesses a letter that is not in the hidden word, show an appropriate message [3 marks]. If the user guesses a letter that appears more than once in the hidden word, make sure to replace each correct instance. When the user finishes the word, show a count of the number of guesses.[3 Marks] [8]

Section - II

Answer all questions (7 X 12 Marks = 84 Marks)

03. Predict the output of the following program and explain the program. (5+3+4) [12]
- a) #include<stdio.h>
int main()
{
int a = 7, b = 11;
printf("a = %d, b = %d", a, b);
printf(" a&b = %d", a&b); ~
printf(" a|b = %d", a|b); ~
printf(" a^b = %d", a^b); ~
printf(" ~a = %d", a = ~a); ~
printf(" ~b = %d", b = ~b); ~
return 0;
}

```

b) #include<stdio.h>
int main(){
    char *name="TN_31 AD_4324";
    int x;
    char *cptr = name;
    while(*cptr != '\0')
    {
        cptr++;
    }
    x = cptr - name;
    printf("%d", x);
    return 0;
}
c) #include<stdio.h>
int main()
{
    int x = 1, y;
    y = (x++, printf("1- x = %d ", x), ++x, printf("2- x = %d ", x), x++);
    printf("3- y = %d ", y);           23 uu
    printf("4- x = %d ", x);
    return 0; }
```

- 04 ABC Educational Institution has initiated a scholarship program aimed at recognizing students' academic achievements in Maths, Physics, and Chemistry, alongside their sports accomplishments, during the admission process. The scholarship amount is determined based on the students' average marks. The university collects a total fee of Rs. 1,50,000 from admitted students. Scholarship percentages are awarded as follows:

[12]

Above 90%: 50%

80% - 89%: 25%

70% - 79%: 10%

60% - 69%: 5%

Below 60%: No scholarship

Write a C program that uses nested structures to manage student data, including their academic and sports performance. The program should perform the following tasks:

- Define a structure named Student with the following members: Student ID, Student Name, Sports Marks and Marks in Maths, Physics, and Chemistry should be declared as nested structure within Student structure. (3 marks)
- Calculate the average marks obtained by each student, considering both academic and sports performance. (2 marks)
- Determine the scholarship percentage for each student based on their average marks, according to the predefined conditions. (3 marks)
- Calculate the fees to be paid by each student after applying the appropriate scholarship percentage. (2 marks)
- Display the following details for each student: Student ID, Student Name, Average Marks, Scholarship Percentage, Fees After Scholarship. (2 marks)

Q5 Imagine you're organizing an expo featuring various exhibits and demonstrations. Attendees can purchase tickets priced at Rs. 10 each to access the event. A booth is set up to manage ticket sales and track the number of attendees, along with the total revenue collected. To streamline operations, a class named ExpoBooth is utilized, containing members for the number of attendees and the total revenue. Various operations are implemented to manage the booth effectively. [12]

Write a C++ program and implement specified operations. The program should include the following functions with default arguments:

- i. Initialize both the number of attendees and the total revenue to 0. (2 marks)
- ii. Increment only the total number of attendees if a ticket is not sold out. (default argument: 0 indicating no tickets sold). (2 marks)
- iii. Increment both the total number of attendees and the total revenue if a ticket is sold out. (default argument: 1 indicating one ticket sold). (4 marks)
- iv. Display the total number of attendees and the total revenue collected and the number of tickets sold. (2 marks)
- v. Additionally, if the number of tickets sold out exceeds a certain threshold (e.g., 100 tickets), display a message indicating that the expo is almost sold out. (2 marks)

06. In the SocialNet platform, users can create different types of posts: Text, Image, and Video. All posts share common attributes such as authorship, timestamps, and visibility settings. [12]

Implement the below task,

- i. Define a base class Post with common attributes like author, timestamp, and visibility.(2 Marks)
- ii. Implement derived classes TextPost (with No_of_text, Text_Language), ImagePost (with No_of_Images, size_Image, type_Image), and VideoPost (with size_Video, type_Video) to represent specific post types. Each derived class should inherit from the Post base class and implement its own content-related attributes and method such as get_data() to get information. (6 Marks)
- iii. Ensure that the derived classes override a common method, such as display(), to provide specialized behavior for each post type, while still retaining the shared functionality from the base class. (4 Marks)

07. Write a C++ program to calculate the perimeter of a quadrilateral. [12]

The program should have a Point class with two private data members for the x-coordinate and y-coordinate. Also, the Point class should have public setter and getter functions to initialize and display the Points respectively. The program should prompt the user in the main function to input the coordinates of four points representing the corners of the quadrilateral. Upon the entry from the user, the Point class objects must be declared and initialized using the setter function and displayed using the getter function.

The Point class should overload the subtraction \ominus operator to find the distance between two points. This overloading function should use the basic two-point distance formula of a X-Y coordinate to find the distance. This overloaded function must be called from the main function with the following code snippet:

vector
operator
→ class

double sideLengthPIP2 = P1-P2;

Here, $P1$ and $P2$ are the two point objects whose distance is being calculated and $sideLengthPIP2$ is the distance between them. Similarly, the side length between each consecutive point must be found in the main function, thus eventually calculating and displaying the perimeter by adding these four side lengths.

[12]

08. Implement a C++ program that defines a function template named "average" to find the average of an array of values of any data type. The program should use the average function template to find the average of the following:

i. An array of integers: {10, 20, 30, 40, 50}. [2 Marks]

ii. An array of floating-point numbers: {3.5, 4.7, 6.2, 8.9, 9.1}. [2 Marks]

iii. An array of characters (interpreting characters as their ASCII values): {'a', 'b', 'c', 'd', 'e'}. [2 Marks]

iv. An array of custom objects (e.g., Employee objects with a salary attribute): {Employee(2500.0), Employee(3500.0), Employee(4500.0), Employee(5500.0), Employee(6500.0)}

Ensure that your program demonstrates the functionality of the average function template by correctly finding the average values for each of the above scenarios. [6 Marks]

[12]

09. Consider a class *Vector* representing a mathematical vector in 3D space. The class has three private data members: *x*, *y*, and *z*, representing the components of the vector along the *x*-axis, *y*-axis, and *z*-axis, respectively.

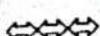
Implement a member function named "multiply" that takes another Vector object as an argument and multiplies its components individually to the components of the current object. The function should return a new Vector object representing the product of the two vectors.

Your task is to implement the multiply function using the "this" pointer to access the components of the current object and the argument object. Provide a main function to demonstrate the usage of the "multiply" function by multiplying two vectors and printing the result. Define appropriate constructors to initialize the data members. The code to call the "multiply" function in the main method is as follows where *v1* and *v2* are objects of Vector class.

Vector prod = v1.multiply(v2);

As with the above multiply function, implement a "dotProduct" function that finds the dot product of two vectors. In this case, the sum of the three components of the resultant vector "prod" is the dot product.

Write the complete C++ code to implement the Vector class and demonstrate the multiplication of two Vectors using the multiply function. Also, demonstrate the dot product of two vectors using the result of the multiplication function. Define appropriate constructors to initialize these data members.





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Final Assessment Test (FAT) - May 2024

Programme	B.Tech.	Semester	WINTER SEMESTER 2023 - 24
Course Title	STRUCTURED AND OBJECT-ORIENTED PROGRAMMING	Course Code	BCSE102L
Faculty Name	Prof. SHREE PRAKASH	Slot	B1
Time	3 Hours	Max. Marks	100

General Instructions:

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Section - I

Answer all questions (2 X 8 Marks = 16 Marks)

01. In a gymnastics or diving competition, each contestant's score is calculated by dropping the lowest and highest scores and then adding the remaining scores. Write a C program that allows the user to enter eight judges' scores and then outputs the point scored by the contestant. A judge awards point between 1 and 10, with 1 being the lowest and 10 being the highest. For example, if the scores are: 9.2, 9.3, 9.0, 9.9, 9.5, 9.5, 9.6 and 9.8, then the contestant receive a total of 56.9 points. [8]

02. Explain the use of dynamic memory allocation and structures in a C program to manage mobile phone brands and their quantities in a mobile shop. Justify the relevance of dynamic memory allocation for handling an arbitrary number of brands. Use appropriate functions for purchasing and selling phones, including the use of pointers to access and modify data within dynamically allocated memory. [8]

- Discuss the advantages of using dynamic memory allocation and structures in a C program to manage mobile phone brands and their quantities in a mobile shop. (2 Marks)
- Provide syntax and code demonstrating the implementation of dynamic memory allocation and functions for purchasing and selling phones.(4 Marks)
- Emphasize the use of pointers to access and modify data within dynamically allocated memory. (2 Marks)

Section - II

Answer all questions (7 X 12 Marks = 84 Marks)

03. Trace the execution step by step and write the output of the following code snippets (4+4+4=12 marks) [12]

```
(i)
#include <stdio.h>
#define display printf
int main()
```

```

    {
        int i=0;
        for(display("%d ",++i);display("%d ",++i);display("%d ",++i))
        {
            display("%d ",++i);
            if(i>8)
                break;
        }
        return 0;
    }

```

(ii)

```

#include <stdio.h>
#include <math.h>
int main()
{
    int a=4, b=5, c=6, i, d, s = 0;
    s = (b * (2 * a + (b - 1) * c)) / 2;
    d = a + (b - 1) * c;
    for (i = a; i <= d; i = i + c)
    {
        if (i != d)
            printf("%d + ", i);
        else
            printf("%d = %d", i, s);
    }
    return 0;
}

```

(iii)

What will be the output of the program?

```

#include<stdio.h>
int main()
{
    int i=4, j=-1, k=0, w, x, y, z;
    w = i || j || k;
    x = i && j && k;
    y = i || j && k;
    z = i && j || k;
    printf("%d, %d, %d, %d\n", w, x, y, z);
    return 0;
}

```

04. An engineering company keeps track of its employees' names, IDs, designations, years of experience, and salaries. The corporation decides to increase salaries by 12% for employees with more than or equal to 5 years of experience. Create a salary-increment function to increase salaries by 12% for employees with more than or equal to 5 years' experience. [12]

- i. Write a program in C to create a structure Employeeinfo with appropriate members. (5 Marks)
- ii. Display the employee details after increasing the compensation for the employees based on the aforementioned criteria. (7 marks)
05. In a school management system, there are two classes: Student and Teacher. The Student class [12] contains private data members such as name, age, subjects, and grades (assuming multiple subjects are taught). The Teacher class includes private data members like name, subjects, and teacherID. You need to create a third class called SchoolRecords that is not derived from either Student or Teacher but requires access to their private data members to generate comprehensive reports.
- i. How would you declare the SchoolRecords class so that it can access private members of both Student and Teacher classes to generate reports? (4 Marks)
- ii. Write C++ code for the Student and Teacher classes to calculate the average of grades for each student from array of objects across all subjects. If the average is greater than 50, print the result as "pass"; otherwise, print "fail". Sort the student database in ascending order of average marks and print the details of each student and teacher in SchoolRecords. (8 Marks)
06. As a software developer tasked with designing an online shopping system, you are required to [12] create a class hierarchy to represent various products available for purchase. The system should support different types of products, such as electronics and clothing, each with specific attributes and behaviors.
- i. Design and implement a base class named Product to represent individual products. This class should contain attributes such as name, price, and quantity in stock. Additionally, create intermediate classes for specific product types, such as Electronics and Clothing, which virtually inherit from the Product class. Identify and implement the appropriate inheritance model for these intermediate classes.(6 Marks)
- ii. Create a derived class named DiscountProduct that virtually inherits from both Electronics and Clothing classes, demonstrating multi-path inheritance.(3 Marks)
- iii Develop a function named displayAvailableProducts() outside the class hierarchy. This function should be responsible for displaying the names and prices of products that are available for purchase, meaning those with a quantity in stock greater than 0. (3 Marks)
07. Develop a Banking Employee Management System in C++ utilizing operator overloading to [12] streamline various employee management tasks. Create a class named *Employee* to encapsulate banking employee information, including unique identifiers like *Employee ID*, *Name*, *Position/Role* (e.g., Manager, Teller, Loan Officer), and *salary* using necessary constructors, accessor methods, and necessary member functions to manipulate employee data effectively. [4 marks]. Enhance comparison capabilities by overloading the equality (==) and inequality (!=) operators to compare employee objects based on attributes such as ID, name, and salary. Additionally, empower salary increment operations by overloading the plus (+) operator to accommodate percentage-based increments. [4 marks]. Develop essential functions to perform key operations within the system, including adding new employees, displaying all employee details, searching for employees by ID, name, or position, and providing salary increments. [4 marks].
08. Create a program for managing Teaching Assistants (TAs) at VIT University. This curriculum [12] should concentrate on two major areas: astrobiology and quantum mechanics. Create a configurable 'TA' class with templates that can manage TAs from various departments. Each TA

should contain basic information such as name, ID, course assignment, and role. Use template specialization to change department-specific characteristics, such as showing the department's name. The program should allow users to enter TA details, examine all TAs and their attributes depending on department and role, and quit cleanly when required.

09. Consider a scenario where you've(customer) been diligently saving money for 10 years in a bank account named *AddAmount*. You start with an initial deposit of 50 rupees. During the first year, neither you nor the bank adds any money to your account. However, in the second year, you decide to deposit an additional 200 rupees, but the bank doesn't contribute anything. Starting from the third year onwards, you consistently add 100 rupees each year, while the bank supplements your savings by adding 10% of the previous year's balance as interest.
- i. Write a C++ program that implements constructors to handle the money for the first, second, and subsequent years. Compute the final amount in your account after 10 years. (6 marks)
- ii. After 10 years, customer decides to extend the savings scheme for another 5 years with the bank offering the same interest rate. However, the bank imposes a condition: every year, he must add 2 new customers to his bank. If this condition is met, an additional 5 percent interest will be credited to his account annually. Write an inline function named *calculateAdditionalInterest* to calculate the extra interest amount each year. (6 Marks)





VIT[®]

Vellore Institute of Technology
(Deemed to be University under section 3 of the UGC Act, 1956)

Reg. No. :

23BAI1489

Final Assessment Test(FAT) - Nov/Dec 2024

Programme	B.Tech.	Semester	Fall Semester 2024-25
Course Code	BCSE304L	Faculty Name	Prof. Nathezhtha T
Course Title	Theory of Computation	Slot	A2+TA2
		Class Nbr	CH2024250100912
Time	3 hours	Max. Marks	100

General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Course Outcomes

1. Compare and analyze different computational models
2. Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
3. Identify limitations of some computational models and possible methods of proving them.
4. Represent the abstract concepts mathematically with notations.

Section - I

Answer all Questions (1 × 10 Marks)

Q.No	Question	*M - Marks		
		*M	CO	BL
01.	Using mathematical induction prove that the sum of cubes of n natural numbers is equal to $\left(\frac{\ln(n+1)}{2}\right)^2$ for all n natural numbers. To illustrate the validity of your proof, calculate and verify the base case for the first three smallest values of n, and then proceed to show two inductive steps. (10 Marks)	10	1	3

Section - II

Answer all Questions (6 × 15 Marks)

Q.No	Question	*M - Marks		
		*M	CO	BL
02.	a) A magic basket will generate a bunch of flowers where if you pick a jasmine then it will generate double Spanish ^{jasmine} . Consider the above magic basket as a language and generating flowers as a string. Write a language and the sample strings. Check whether the language is regular or not. (5 Marks) b) Build an equivalent regular expression with appropriate steps for the given finite automata N.	15	1,2	3

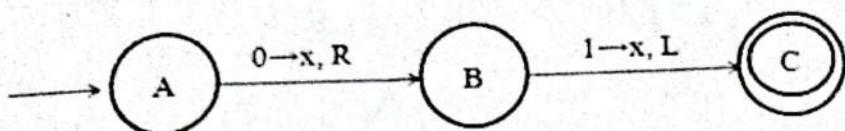
N = ($\{q_1, q_2, q_3\}$, $\{a, b\}$, δ , q_1, q_3) where δ is defined in the table (7 Marks)

States	a	b
$\rightarrow q_1$	q_2	q_1
q_2	q_3	q_1
$*q_3$	q_3	q_2

c) Let C_1 is a regular language, whether the Kleen and Positive closure of C_1 will be a regular or not? Prove and explain with an example. (3 Marks)

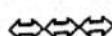
03. There are two rooms A and B with lights, but with a single control switch for both rooms. Hence 15 2 3
 lights in rooms are both on or both off at any point. The goal is to build an automatic control system that manages this switch. There is a sensor that detects motion in the two rooms and sends data to the controller; the controller reads these two signals and then instructs whether the switch should be turned on or off. We would like the controller to turn the lights on when motion is detected in either room, and turns them off if both rooms are empty for two consecutive signals from the sensor. Assume that the system starts from the state when lights are off. The sequence of events and actions is represented by the alphabet $\Sigma = \{\text{yes}, \text{no}, \text{on}, \text{off}\}$. Sequences accepted are of the form: $r_1 s_1 t_1 r_2 s_2 t_2 \dots r_n s_n t_n$ where each $r_i \in \{\text{yes}, \text{no}\}$ and stands for the signal coming from Room A, each $s_i \in \{\text{yes}, \text{no}\}$ stands for the signal coming from room B, and each $t_i \in \{\text{on}, \text{off}\}$ stands for the instruction the controller gives to the switch.
 a) Design a DFA that accepts precisely the sequences that conform to the behavior of the controller (9 Marks).
- Example of good sequences:
 (i) no, no, off (ii) yes, yes, on, yes, no, on, no, no, off
- Example of bad sequences:
 (i) yes, no, on, no (ii) no, no, yes
 b) Minimize the above DFA. (6 Marks)
04. Consider the given grammar 15 3 3
 $S \rightarrow aAbB$
 $A \rightarrow aA \mid C$
 $B \rightarrow Bb \mid \epsilon$
 $C \rightarrow a$
 $D \rightarrow AB \mid d$
 a) Simplify the given grammar (6 Marks)
 b) Convert the given context free grammar into its equivalent Greibach normal form (9 Marks)
05. A data encoding system for a messaging application requires messages to follow a specific structure to ensure proper organization and integrity. The message format must adhere to the following rules: 15 3 3
 i. The message begins with one or more occurrences of the character 'a'.
 ii. This is followed by one or more occurrences of the character 'b'.
 iii. In the sequence, character 'c' appears after character 'b', with 'c' occurring the same number of times as 'b'.
 iv. The message ends with sequence of character 'd', with the same number of occurrences as of the character 'a' given at the beginning.
 a) Construct the language for the above (3 Marks)
 b) Design a PDA that accepts messages adhering to this structure (9 Marks).
 c) Illustrate the step by step changes of stack (3 Marks)
06. A secret code generator is required for securing a messaging application. The codes are 15 3 3
 generated based on two input values provided by the user.
 The following function is used to generate the secret code
 $f(a,b)=2a+b$.
 Where a and b are the input value, $a \geq 1$, and $b \geq 0$.
 a) Design a Turing Machine to implement function $f(a,b)$ (9 Marks).
 b) For sample input $a=2$ and $b=3$, illustrate the step by step changes of the tape (6 Marks).

07.



Convert the above Turing Machine (TM) into Modified Post Correspondence Problem (MPCP) (7 Marks) and determine whether a solution exists in the context of the Post Correspondence Problem (PCP) for the input string "010." Use this to prove the undecidability of the PCP (8 Marks).

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)





Final Assessment Test(FAT) - Apr/May 2025

Programme	B.Tech.	Semester	Winter Semester 2024-25
Course Code	BCSE304L	Faculty Name	Prof. Renuka Devi
Course Title	Theory of Computation	Slot	E2+TE2
Time	3 hours	Class Nbr	CH2024250502105
		Max. Marks	100

Instructions To Candidates

- Write only your registration number in the designated box on the question paper. Writing anything elsewhere on the question paper will be considered a violation
- Note: Answers submitted without the appropriate accompanying problem-solving steps will not be awarded any credit.

Course Outcomes

CO1: Compare and analyse different computational models

CO2: Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.

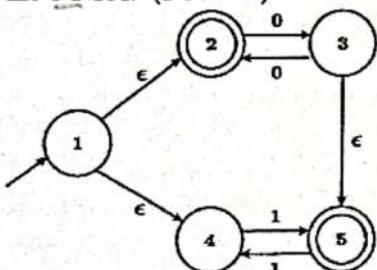
CO3: Identify limitations of some computational models and possible methods of proving them.

CO4: Represent the abstract concepts mathematically with notations.

Answer all Questions (10 × 10 Marks)

01. (i) Design DFA for the following languages over $\{0, 1\}$. The set of all strings in which every sequence of five consecutive symbols contains at least two 0s. (4 Marks)

(ii) Let M be the 5-state NFA with ϵ -transitions shown in the diagram below. Compute Regular Expression of the ϵ -NFA. (2 Marks)

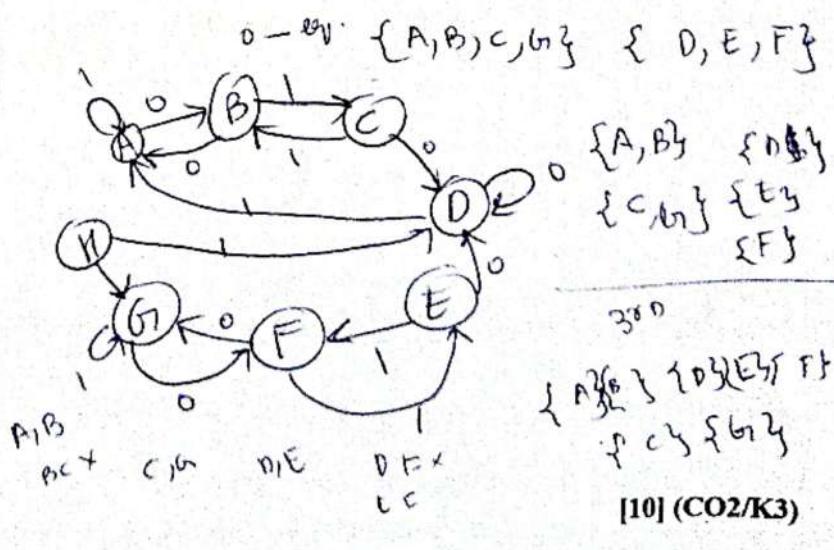


(iii) Construct a regular expression over $\Sigma = \{a, b\}$ for the set of all strings that start and end with the same symbol, contain an even number of a's, do not contain the substring "bab", and ensure that every occurrence of "bb" is immediately followed by an "a". (4 Marks)

[10] (CO1/K3)

02. For the given Transition table of a DFA, draw the table of distinguishabilities and construct the minimum state equivalent DFA.

State/Input	0	1
→ A	B	A
B	A	C
C	D	B
*D	D	A
*E	D	F
*F	G	E
G	F	G
H	G	D



- Q3. Convert the following grammar $G = (\{S, A, B, C, D, E\}, \{a, b\}, P, \{S\})$ into Greibach Normal Form [GNF].
- $S \rightarrow aAa \mid bBb \mid \epsilon$
 $A \rightarrow C \mid a$
 $B \rightarrow C \mid b$
 $C \rightarrow CDE \mid \epsilon$
 $D \rightarrow A \mid B \mid ab$

[10] (CO3/K3)

- Q4. (a) Check whether the language $L = \{0^{2^i} \mid i \geq 1\}$ is context-free or not. (5 Marks)
(b) Construct CFG for the following Language $L = \{ w \mid w \text{ contains } \{0, 1\} \text{ where } W_c(0) = W_c(1) \text{ in any order}\}$. W_c denotes the input symbol count (5 Marks)

[10] (CO3/K3)

- Q5. Consider the following ϵ -NFA

States/Input	ϵ	0	1	2
$\rightarrow q_1$	$\{q_3\}$	$\{q_1, q_2\}$	\emptyset	\emptyset
q_2	\emptyset	\emptyset	$\{q_3, q_4\}$	\emptyset
q_3	$\{q_2, q_4\}$	\emptyset	\emptyset	$\{q_4\}$
$*q_4$	\emptyset	$\{q_1\}$	$\{q_4\}$	\emptyset

- (i) Compute the ϵ -closure for each state. (2 Marks)
(ii) Give all the strings of length three or less accepted by the automaton. (2 Marks)
(iii) Convert the automaton to a DFA. (6 Marks)

[10] (CO2/K4)

- Q6. A software company is developing a compiler that must validate specific lexical patterns in source code. They use regular languages to define token patterns and need to ensure certain operations like union, intersection, and complementation are preserved under optimization. Given two regular languages L_1 and L_2 representing different token sets, analyze how closure properties assist in verifying the correctness of combining or transforming these patterns. Propose a strategy using closure operations to prove whether the language defined by $(L_1 \cap \neg L_2) \cup (L_2 \cap \neg L_1)$ is regular where $\neg L_2$ refers to the complement of the regular language L_2 and justify your answer.

[10] (CO1,2/K4)

- Q7. Analyze the language $L = \{a^n b^{2n} c^m d^{3m} \mid \text{where } n \geq 0, m \geq 0\}$ and Construct a Pushdown Automaton (PDA) that accepts this language using appropriate stack operations. Further illustrate the PDA's behavior on the input aabbccddddddddd.

[10] (CO3/K4)

- Q8. Design a Turing Machine that will recognize strings of the language $\{w \mid w \in \{0, 1, (,)\} \text{ where } w \text{ is a palindrome, contains balanced parentheses, and an even number of 0's}\}$. Verify the input string (00011000).

[10] (CO3/K4)

- Q9. Design a Turing Machine for the $L = \{w \in \{a, b, c\}^* \mid w = a^n b^m c^k \text{ such that } m \geq 0, n = m^2 \text{ and } k = 2^m\}$. Analyze how the Turing Machine utilizes state transitions and tape movements to achieve the goal and Illustrate your answer with one complete trace for the valid and invalid input strings.

[10] (CO3/K4)

- Q10. Prove that the following problems are not recursively enumerable:

- (i) The set of pairs (M, w) such that Turing Machine M , started with input w , does not halt. (3 Marks)
(ii) The set of pairs (M_1, M_2) such that Turing Machine M_1 and M_2 , $L(M_1) \cap L(M_2) = Q$ (2 Marks)
(iii) The set of triples (M_1, M_2, M_3) such that $L(M_1) = L(M_2)L(M_3)$; i.e., the language of the first is the concatenation of the languages of the other two TM's. (5 Marks)

[10] (CO4/K3)





VIT

Vellore Institute of Technology
CHENNAI

Reg.
Number:

Continuous Assessment Test (CAT) – I January 2025

Programme :	B.Tech. CSE (BAI, BDS,BRS and BPS)	Semester :	Winter 2024-25
Course Code & Course Title :	BCSE304L THEORY OF COMPUTATION	Class Number :	CH2024250502272 CH2024250502105 CH2024250501768 CH2024250502298
Faculty :	Dr. P.Saravanan Dr. Renuka Devi R Dr. Natarajan B Dr. S K. Karthika	Slot :	E2+TE2
Duration :	90 MINUTES	Max. Mark	50

General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information.

Answer all questions

Q. No	Sub Sec.	Description	Marks
1.	(a)	<p>A security system requires users to enter a password that meets specific criteria. The system accepts a password if it follows these rules.</p> <ol style="list-style-type: none"> The password must contain at least one uppercase letter (A-Z). The password must contain at least one digit (0-9). The password must end with a special character (*, #, or @) Passwords that do not meet these criteria are rejected. <p>Construct a Deterministic Finite Automaton (DFA) that validates the above scenario based on the above rules. (5 Marks)</p> <p>Design a DFA for a language over $\Sigma = \{0,1\}$ that accepts strings meeting the following conditions:</p> <ol style="list-style-type: none"> The string must contain at least one occurrence of "01" as a substring. (4 Marks) The string must not contain "11" as a substring. (4 Marks) 	13
2.		<p>Consider the problem of constructing an automaton to accept the set of all inputs that are binary numbers divisible by 4 or by 6. The automaton must accept binary representations of 0,4,6,8,12,16,18,20, etc., but should reject 2,10,14,22,etc, apart from all odd numbers. Design a NFA that accepts only the set of all inputs that are binary numbers divisible by 4 or by 6. Validate your NFA by reading the input strings 10100 and 10101.</p>	10

21



The ϵ - Non-Deterministic Finite Automaton (ϵ - NFA) is given as a transition table.

δ	ϵ	a	b	c
$\rightarrow q_0$	$\{q_1, q_2\}$	Φ	Φ	Φ
q_1	Φ	$\{q_1, q_3\}$	$\{q_2\}$	Φ
q_2	Φ	$\{q_3\}$	Φ	Φ
$*q_3$	Φ	Φ	$\{q_2\}$	Φ

07

Convert the given ϵ -NFA into a Deterministic Finite Automaton (DFA) with the following.

- Write step by step procedure to find the e-closure sets, and constructing states. (3 Marks)
- Draw the State transition diagram of its equivalent DFA along with the transition table. (4 Marks)

Optimize the given Deterministic Finite Automaton (DFA), represented by the provided transition table, by minimizing it to improve efficiency while preserving its functionality. Clearly document each step of the minimization process, from identifying indistinguishable states to forming the optimized DFA, and ensure the resulting DFA retains the functionality of the original system.

States	a	b
$\rightarrow A$	B	E
B	C	H
*C	D	H
D	E	H
E	F	I
*F	G	B
G	H	B
H	I	C
*I	A	E

10

- 4.
- (a) Convert the following regular expression into its equivalent NFA with epsilon transitions over the alphabet $\Sigma = \{0, 1, 2, 3\}$. (5 Marks)

$$00(1+2+3)^*21(0+1)$$

- (b) A file management system needs to identify and categorize filenames based on the following criteria:

The filename must start with an alphabetic character (A-Z or a-z).

- It may contain alphanumeric characters (A-Z, a-z, 0-9) and underscores (_).
- The filename must have a file extension, which:
 - Starts with a period (...).
 - Contains only lowercase letters (a-z).
 - Has a length of 2 to 4 characters.

Write a regular expression to validate the filenames based on the given criteria. (5 Marks)

10

**Final Assessment Test(FAT) - Nov/Dec 2024**

Programme	B.Tech.	Semester	Fall Semester 2024-25
Course Code	BCSE205L	Faculty Name	Prof. Kaja Mohideen A
Course Title	Computer Architecture and Organization	Slot	A2+TA2
Time	3 hours	Class Nbr	CH2024250100888
		Max. Marks	100

General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Course Outcomes

1. Differentiate Von Neumann, Harvard, and CISC and RISC architectures. Analyze the performance of machine with different capabilities. Recognize different instruction formats and addressing modes. Validate efficient algorithm for fixed point and floating point arithmetic operations.
2. Explain the importance of hierarchical memory organization. Able to construct larger memories. Analyze and suggest efficient cache mapping technique and replacement algorithms for given design requirements. Demonstrate hamming code for error detection and correction.
3. Understand the need for an interface. Compare and contrast memory mapping and IO mapping techniques. Describe and Differentiate different modes of data transfer. Appraise the synchronous and asynchronous bus for performance and arbitration.
4. Assess the performance of IO and external storage systems. Classify parallel machine models. Analyze the pipeline hazards and solutions.

Section - I
Answer all Questions (10 × 10 Marks)***M - Marks**

Q.No	Question	*M	CO	BL
01.	<p>Assume that you are working on a project for a system with limited computational power. You are assigned a task of designing a multiplication algorithm for signed integers. Apply an efficient algorithm that reduces the number of operations by treating the multiplier as the difference between two numbers.</p> <p>i). Evaluate the algorithm using 2's complement representation of the following numbers and show the step-by-step process. (8 marks)</p> <p>A=010111 B=110110</p> <p>ii). How many passes have NO arithmetic operations during multiplication process? (2 marks)</p>	10	1	2

02. Consider a computer system with instructions and data are 16 bits long. The instruction format provides 4 bits for the opcode and the memory is organized as 16-bit words. Assume that the Program Counter (PC) currently holds value 300. The contents of memory locations and partial opcodes are given below. Assume that Instruction Register (IR) and Accumulator (AC) are empty initially.

i). Execute four instructions starting from memory location 300 and show the contents in hexadecimal for the registers PC, IR and AC. (8 marks)

ii). How many memory references are involved for executing the below four instructions? (2 marks)

Contents of memory

Memory location	Contents (Hexadecimal)
300	1502
301	6500
302	5501
303	2502
....	
500	22A4
501	1502
502	91A5

Partial list of Opcodes

Opcode (Binary)	Comment
0001	Load Accumulator from memory
0010	Store Accumulator to memory
0101	Add to Accumulator from memory
0110	Subtract from Accumulator

03. An Intel processor-based computer system uses 32-bit floating-point registers A, B, and C to store floating point numbers. Register A and Register B contain the values 0xC2A40000 and 0xC0A00000 (hexadecimal notation).

10 1 3

i). Show the floating-point numbers stored in Register A and Register B in IEEE excess-127 format. (4 marks)

ii). Perform C = A/B and show the contents of Register C in IEEE excess-127 format. (6 marks)

04. Assume that you are working on a project for controlling a robotic arm. The processor that controls the robotic arm reads the sensor data, calculates movements, and sends instructions to actuators. The operations(movements) performed by robotic arm are MOVE_UP, MOVE_DOWN, CLUTCH, PICK_UP, PUT_DOWN, MOVE_LEFT, MOVE_RIGHT, ROTATE. The processor uses 64 registers to store sensor values, memory of size 2KB and operates on 16 bits data. The controlling processor supports the following instruction types.

10 2 4

Type 1 instructions: Instructions where one input register, one memory operand and one output register are involved

Type 2 instructions: Instructions where two input registers, one output register and one immediate value are involved

Type 3 instructions: Instructions where one input and one output register are involved

i). For each type of instruction, how many bits are required? Assume that the Embedded system requires that all instructions to be a multiple of 8 bits in length. (6 marks)

ii). Following table shows the frequency of instructions and the clock cycles required for the robotic arm program. How long does the program take to complete its execution in a processor with 200MHz clock? (4 marks)

Type	Frequency	Clock Cycles
Type 1	20%	4
Type 2	70%	5
Type 3	10%	3

05. i). A processor with cache memory of 4 cache lines uses 2-way set associative mapping and First-In-First-out Replacement policy. The cache memory is initially occupied with blocks 9, 2 and the remaining blocks are empty. The processor generates memory address references 2,7,9,2,2,8,3,4,7,2,2,5,4,5 during program execution. Show the final contents of Cache memory and calculate number of cache hits and misses. (8 marks) 10 2 2
- ii). The access time is 1 nanosecond for a read operation with a hit in cache, and 5 nanoseconds for a miss in cache. Calculate the Average Memory Access Time for the memory address references given in 5.(i) (2 marks)
06. A high-speed storage device is connected to a processor and can transfer data directly to the main memory with minimal processor intervention. Assume that the processor operates at 2GHz clock and the storage device operates at a speed of 1000 characters per second. Each character is represented by one byte. Identify a suitable technique for bulk data transfer and explain the steps involved in the given scenario with appropriate diagram. 10 3 1
07. A fault-tolerant memory system needs to handle 8 - bit data words, where each data word is accompanied by additional bits to facilitate error correction. The system deploys a mechanism that can correct single-bit errors. 10 2 3
- i). Assume that the system handles a data word 143_{10} . Apply the necessary steps for finding additional bits and show final codeword stored in the memory. (5 marks)
- ii). Consider that there is an error at the 5th bit position from the most significant bit in the code word. How does the error correction mechanism find the error bit position and correct the bit? (5 marks)
08. Consider a small IT company that decides to store its large volume of data using RAID technology. Currently, it has a capacity of 100TB. The company's Chief Data Officer is given the option of choosing either RAID 1 or RAID 5. 10 4 4
- i). If each disk in the array can store 20TB of data and each block of size 20MB, how many disks are needed in RAID 1 and RAID 5? (2 marks)
- ii). Determine the number of disk failures that can be tolerated in both RAID 1 and RAID 5. Justify your answer. (4 marks)
- iii). Compare both RAID 1 and RAID 5 in terms of cost, storage efficiency and data transfer rate. Which option would you prefer for the given requirement? Justify your answer.(4 marks)
09. A four stage (Fetch(F), Decode(D), Execute(E), Write(W)) pipeline processor processes a program with 10 instructions (I_1, I_2, \dots, I_{10}). Each pipeline stage delay is 4ns and intermediate storage buffer delay is 1ns. 10 4
- i). Draw the timing diagram for Non-pipelined and Pipelined execution for the given program and calculate the pipeline Speed up achieved in the 4-stage pipeline. (5 marks)
- ii). Instruction-3(I_3) is a Branch instruction and the Brach is taken to Instruction-8 (I_8) during the program execution. Find the Branch penalty (in ns) and the total execution time (in ns). (5 marks)

10. i). Consider a program that has Integer Arithmetic operations constituting 60% of the execution time and Floating-Point operations constituting 40% of the execution time. You can make the Integer Arithmetic run at most 4 times faster and the Floating-Point Arithmetic run at most 7 times faster. If you can make improvement in Integer Arithmetic operations, determine the Overall Speed-up Achieved.(4 marks) 10 4 2

ii). Given a superscalar processor that can handle two instructions at a time at each stage of a 4-stage pipeline with stages F(Fetch), D(Decode), E(Execute), WB (Write Back). All pipeline stages take one clock cycle except for the Execute(E) stage. For simple integer arithmetic and logical instructions, the Execute(E) stage takes one cycle, but for a LOAD from memory, five cycles are consumed in the Execute(E) stage.

Consider the following sequence of instructions, where the syntax consists of an opcode followed by the destination register followed by one or two source registers:

1 ADD R3, R1, R2

2 LOAD R6, [R3]

3 AND R7, R5, 3

4 ADD R1, R6, R0

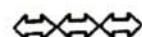
5 ADD R7, R0, 8

6 OR R2, R4, R7

Construct a table for four pipeline stages with entries indicating the clock cycle at which each instruction begins each phase. (6 Marks)

Note: If there is a dependency between two instructions in Question 10.(ii), the result of the first instruction is available after the WB stage for the dependent instruction

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)





Final Assessment Test(FAT) - Nov/Dec 2024

Programme	B.Tech.	Semester	Fall Semester 2024-25
Course Code	BCSE205L	Faculty Name	Prof. Vidhya Lakshmi M
Course Title	Computer Architecture and Organization	Slot	A1+TA1
Time	3 hours	Class Nbr	CH2024250100532
		Max. Marks	100

General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Course Outcomes

1. Differentiate Von Neumann, Harvard, and CISC and RISC architectures. Analyze the performance of machine with different capabilities. Recognize different instruction formats and addressing modes. Validate efficient algorithm for fixed point and floating point arithmetic operations.
2. Explain the importance of hierarchical memory organization. Able to construct larger memories. Analyze and suggest efficient cache mapping technique and replacement algorithms for given design requirements. Demonstrate hamming code for error detection and correction.
3. Understand the need for an interface. Compare and contrast memory mapping and IO mapping techniques. Describe and Differentiate different modes of data transfer. Appraise the synchronous and asynchronous bus for performance and arbitration.
4. Assess the performance of IO and external storage systems. Classify parallel machine models. Analyze the pipeline hazards and solutions.

Section - I**Answer all Questions (3 × 5 Marks)**

Q.No	Question	*M - Marks		
		*M	CO	BL
01.	Analyze the primary structural distinctions between Harvard and Von Neumann architectures and explain how these differences impact data processing and memory access.	5	1	2
02.	A processor has a 5-stage instruction pipeline (Fetch, Decode, Execute, Memory, Write-back). An arithmetic instruction requires 5 cycles to complete. Suppose a load instruction is followed immediately by an arithmetic operation using the loaded data. a) Identify the kind of hazard that might occur, and how could it affect the pipeline's performance? (3 marks) b) How can this hazard be resolved through techniques like data forwarding or pipeline stalls? (2 marks)	5	4	3
03.	Calculate and interpret the average memory access time for a processor with a 90% cache hit rate, given a cache access time of 5 ns and a main memory access time of 50 ns. How do these parameters affect overall performance?	5	2	5

Section - II
Answer all Questions (4 × 10 Marks)

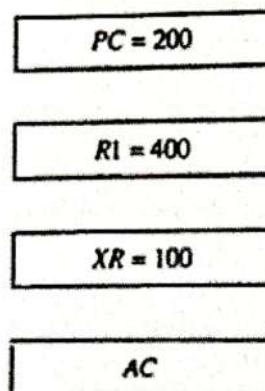
*M - Marks
*M CO BL
10 1 5

Q.No

Question

04. Using Modified Booth's algorithm, multiply the 4-bit binary numbers **0110** (multiplicand) and **0011** (multiplier). Show the detailed step-by-step execution, including all intermediate values of the registers (A, Q, Q-1, M, -M) and the shifts performed at each stage. Finally, interpret the binary result and convert it back to decimal form. 10 1 3
05. Evaluate the effective address and operand value for the following addressing mode
 a) Direct (2marks)
 b) Indirect (2marks)
 c) Index (2marks)
 d) Register indirect (2marks)
 e) Auto Decrement (2marks)
 from the following memory diagram

Address	Memory
200	Load to AC Mode
201	Address = 500
202	Next instruction
399	450
400	700
500	800
600	900
702	325
800	300



06. a) A CPU accesses memory addresses in the following sequence: 0x1A4, 0x2B6, 0x1A4, 0x2B7, 0x2B6. Assume a direct-mapped cache with 4 blocks and each block size is 16 bytes. Determine whether each access results in a hit or a miss. (6 marks) 10 2 5
- b) A cache has 4 blocks, each of size 8 bytes, and the main memory size is 1KB. Calculate:
 i) The number of bits for memory address, tag, and block offset. (2 marks)
 ii) If the memory address is 0x0C7, which block will it be mapped to? (2 marks)
07. A small business is looking to set up a storage solution for their server, with a focus on data redundancy to ensure their data is safe in case of a disk failure. They need a balance between performance, storage capacity, and redundancy. Compare the different RAID levels (RAID 1, RAID 5 and RAID 6) and recommend the most suitable RAID configuration for their needs, considering the pros and cons of each in terms of redundancy, storage efficiency, and cost. 10 4 4

Section - III
Answer all Questions (3 × 15 Marks)

*M - Marks

Q.No	Question	*M	CO	BL
08.	<p>A computer system has multiple devices (CPU, DMA controller, and various I/O devices) that need access to the system bus to read or write data. The bus arbitration mechanism used to decide which device gets control of the bus can be either synchronous or asynchronous. The CPU has the highest priority, followed by the DMA controller and then the other I/O devices. The devices request access to the bus by sending signals to the bus controller, which in turn uses a certain arbitration technique to grant access.</p> <p>a) If the system switches to an asynchronous bus arbitration mechanism, where devices request access without relying on a clock signal, describe how the bus controller would handle multiple simultaneous requests from the CPU, DMA, and I/O devices. (7.5 marks)</p> <p>b) What challenges might arise in terms of timing, and how does the system ensure that higher-priority devices like the CPU get access over lower-priority devices? (7.5 marks)</p>	15	3	4
09.	<p>A processor uses a 5-stage instruction pipeline with the stages: IF (Instruction Fetch), ID (Instruction Decode), EX (Execute), MEM (Memory Access), and WB (Write Back). Each stage takes 1 clock cycle to complete, and the pipeline operates at a clock frequency of 2 GHz. However, due to data hazards, branch instructions, and cache misses, the following events occur:</p> <ol style="list-style-type: none"> 1. A data hazard between two instructions causes a 2-cycle stall. 2. A branch instruction causes a 3-cycle penalty due to misprediction. 3. A cache miss during the MEM stage results in a 4-cycle delay. <p>Given the following sequence of instructions:</p> <ol style="list-style-type: none"> 1. Instruction A (no hazards) 2. Instruction B (data hazard with Instruction A) 3. Instruction C (branch instruction) 4. Instruction D (no hazards) 5. Instruction E (cache miss during MEM stage) <p>a) Calculate the total time in clock cycles to execute the sequence of instructions, considering the stalls and delays. (5 marks)</p> <p>b) Determine the average CPI (Cycles Per Instruction) for this sequence. (5 marks)</p> <p>c) Analyze how the delays impact the overall pipeline performance and suggest strategies to mitigate the impact of each type of stall or delay. (5 marks)</p>	15	4	5
10.	<p>A communication system is transmitting data packets between two computers. To ensure data integrity during transmission, the system uses Hamming code for error detection and correction. Each data packet is 7 bits long, and the system adds parity bits to create a Hamming codeword. During transmission, the following 11-bit Hamming codeword is received:</p> <p>Received Codeword: 10110100101</p> <p>a) Determine if there is an error in the received codeword using Hamming code. If an error exists, identify the erroneous bit position and provide the corrected codeword. (5 marks)</p> <p>b) Explain the steps you took to detect and correct the error in the received codeword. Why is Hamming code suitable for this error detection and correction? (5 marks)</p> <p>c) If the system switches to using a simple parity check instead of Hamming code, how many errors can it detect and correct? Compare the effectiveness of the simple parity check with that of Hamming code. (5 marks)</p>	15	4	5

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)



Continuous Assessment Test-2 – March 2025

Programme	B.Tech (CSE and its Specialization)	Semester	Winter 2024-25
Course	Operating System	Code	BCSE303L
Faculty	Dr. Yogesh C Dr. Indra Priyadarshini S Dr. Nivethitha V	Slot(s)	D2+TD2
Time	1½ Hours	Class Nbr(s)	CH2024250502117 CH2024250502278 CH2024250502277
		Max. Marks	50

Answer ALL Questions

1. a) A university computing center manages shared computational resources allocated to various student research teams. The center provides three types of resources: High-Performance GPUs (A) – Used for deep learning model training, CPU Cores (B) – Required for general computing tasks, High-Speed Storage Units (C) – Used for storing datasets and intermediate results. The computing center has a total of 11 GPUs (A), 6 CPU cores (B), and 7 storage units (C). At a given time t_0 , the system captures the resource allocation snapshot as follows:

Research Team	Allocated Resources (A, B, C)	Maximum Resources Required (A, B, C)
T0	(1, 1, 1)	(4, 3, 2)
T1	(2, 0, 0)	(5, 2, 0)
T2	(0, 0, 1)	(7, 4, 3)
T3	(2, 1, 1)	(3, 3, 3)
T4	(1, 0, 2)	(3, 1, 3)
T5	(3, 2, 0)	(6, 3, 1)

Analyze the given resource allocation state and determine if the system is in a safe state using the Banker's Algorithm. If there is no deadlock, find the sequence in which research teams can complete their work. [5 Marks]

Consider a new request from Team T2 for (0, 1, 0) additional resources. Can this request be granted immediately without violating system safety? Justify your answer by finding the safe sequence. [5 Marks]

- b) A cloud-based AI research cluster manages computational resources for multiple research teams running machine learning experiments. The system has 6 processes (P1, P2, P3, P4, P5, P6) competing for 5 shared resources (R1, R2, R3, R4, R5). Each resource can be assigned to at most one process at a time, and processes may request multiple resources simultaneously. At a given point in execution, the Resource Allocation Graph (RAG) is as follows:

1. P1 holds R1 and waits for R3 and R5
2. P2 holds R3 and waits for R2
3. P3 holds R2 and R5 but waits for R4
4. P4 holds R4 and waits for R1
5. P5 holds R5 and waits for R3
6. P6 holds no resources but waits for R2 and R4

Construct the Resource Allocation Graph (RAG) based on the given data. Convert the RAG into a Wait-for Graph (WFG). Identify whether the system is in deadlock or not. [5 Marks]

2. In an online library system, multiple users can check book availability simultaneously. [10] However, when a user attempts to borrow a book, exclusive access to the book database is required to prevent multiple users from borrowing the same book at the same time. Assume there are four users, where one user only checks book availability, while the remaining three attempt to borrow one book each. The initial available book count is 5. To ensure that book borrowing occurs without race conditions, suggest a suitable synchronization mechanism for handling both book availability checking and book borrowing in this system. Additionally, provide a brief pseudocode or C program implementing the synchronization mechanism, ensuring it prevents deadlocks while allowing concurrent book availability checks. *read write* [5+5 Marks]
3. Design a synchronization mechanism to manage access between a single viewer and a single booker in a ticket booking system. The system must ensure the following: *processes* [10]
- The viewer can read seat information without modifying it.
 - The booker updates the seat information after booking the ticket.
 - Mutual exclusion is enforced to prevent race conditions.
 - The solution ensures fairness, preventing indefinite waiting for either process.
- Implement the solution for two processes with pseudocode that includes `viewer()` and `booker()` functions. [5+5 Marks]
4. A smart manufacturing system utilizes a real-time data processing unit to handle multiple tasks such as machine diagnostics, quality inspection, inventory tracking, and automated decision-making. The system allocates memory dynamically to different processes based on their needs. The memory is divided into 5 partitions of varying sizes: 120KB, 50KB, 200KB, 70KB and 90KB in order. At a particular moment, the following processes require memory allocation: P1: 100KB (Machine Diagnostics), P2: 80KB (Real-time Quality Inspection), P3: 45KB (Inventory Data Processing), P4: 25KB (Sensor Data Logging), P5: 110KB (Automated Decision-Making AI). Apply the First Fit, Best Fit, and Worst Fit algorithms to allocate memory for the processes. Which algorithm causes more external fragmentation? *first fit* [2+2+1 Marks]
5. a) A system has a Logical Address Space (LAS) of 8 GB and a Physical Address Space (PAS) [10] of 512 MB, with a page size of 4 KB. Determine the number of pages in the logical address space, the number of frames in the physical address space, the total number of entries in the page table, and the size of the page table, providing a detailed step-by-step solution. [5 Marks]
- b) In a paging system with 4 pages, a logical address consists of a virtual page number and a 12-bit offset. Given the logical address 8196, the page table maps pages to frames as follows: page 0 to frame 000, page 1 to frame 011, page 2 to frame 110, and page 3 to frame 111. Determine the corresponding physical address by extracting the virtual page number, using it to find the frame number, and constructing the final physical address in decimal. Provide a step-by-step solution. [5 Marks]



Final Assessment Test(FAT) - Apr/May 2025

Programme	B.Tech.	Semester	Winter Semester 2024-25
Course Code	BCSE306L	Faculty Name	Prof. Modigari Narendra
Course Title	Artificial Intelligence	Slot	F2+TF2
		Class Nbr	CH2024250502335
Time	3 hours	Max. Marks	100

Instructions To Candidates

- Write only your registration number in the designated box on the question paper. Writing anything elsewhere on the question paper will be considered a violation.

Course Outcomes

- CO1: Evaluate Artificial Intelligence (AI) methods and describe their foundations.
 CO2: Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge representation and learning.
 CO3: Demonstrate knowledge of reasoning, uncertainty, and knowledge representation for solving real-world problems.
 CO4: Analyse and illustrate how search algorithms play a vital role in problem-solving.

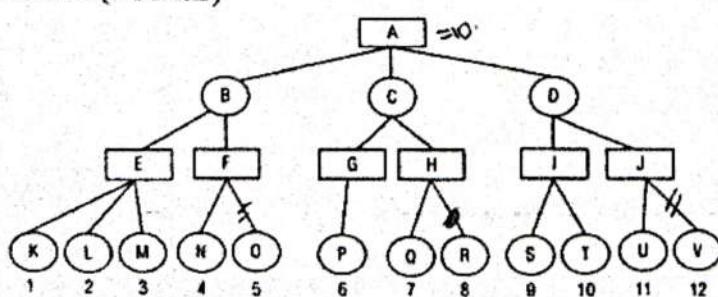
Section - I

Answer all Questions (4 × 10 Marks)

- Q1. A national emergency response agency wants to develop an AI-based disaster response agent to monitor natural disasters, assess damage, and provide real-time response recommendations. The system will use satellite images, drone footage, seismic sensors, and weather data to detect disasters such as earthquakes, floods, and wildfires. The agent will analyze the severity of disasters and suggest optimal response strategies, such as evacuations, resource allocation, and early warnings.
- (i) Suggest a suitable intelligent agent type for this application. Justify your recommendation and explain how it would operate with a supporting diagram. (5 Marks)
- (ii) Identify and characterize seven types of task environments applicable to the AI-based disaster response agent. Explain each in detail with relevance to disaster response operations. (5 Marks)

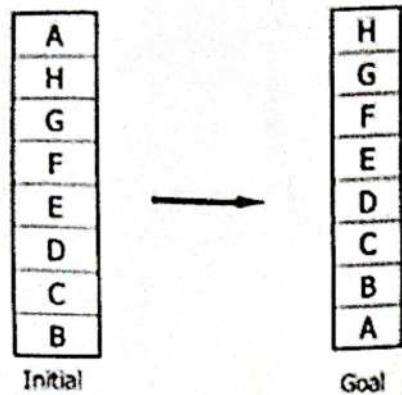
[10] (CO1/K2)

- Q2. In a high-stakes cybersecurity environment, an AI-driven defense system must decide the best countermeasures against incoming cyber threats, such as malware attacks, phishing attempts, and denial-of-service (DoS) attacks. The system operates in real-time and considers the actions of two sophisticated adversarial hackers, Hacker X and Hacker Y, who continuously alter their attack strategies to evade detection. Since evaluating all potential attack paths is computationally expensive, the AI employs a search technique that prunes branches in a minimax decision tree by eliminating suboptimal choices using upper and lower bound estimates to efficiently eliminate less critical threat scenarios, allowing it to focus only on the most imminent and high-risk attacks.
- Given the following decision tree, where the AI aims to minimize system risk while adversaries seek to take advantage of security weaknesses, determine:
- (i) Which attack response branches can be ignored in the minimax decision tree without compromising the optimal defense strategy? (5 Marks)
- (ii) How does pruning improve real-time cybersecurity decision-making compared to evaluating all possible threats? (5 Marks)



[10] (CO2/K3)

03. Assuming a block world problem where multiple blocks are arranged on a table, each with a flat surface allowing another block to rest on top, the objective is to rearrange the blocks from an initial configuration to a target configuration. Blocks can only be moved one at a time, and no two blocks can occupy the same space. Apply local search algorithms to
- Evaluate the effectiveness of local and global heuristics in terms of computational efficiency and the number of moves required. (5 Marks)
 - Analyze which heuristic more effectively avoids local optima and efficiently achieves the goal state. (5 Marks)



[10] (CO4/K4)

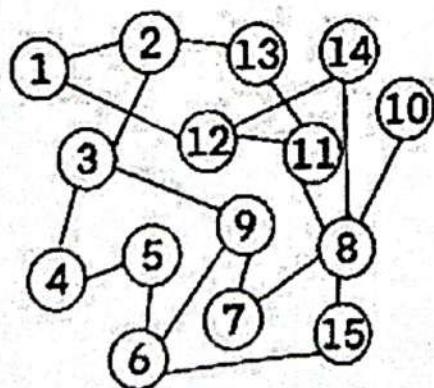
04. A warehouse robot must navigate to pick up a package from a storage location and deliver it to a designated drop-off point. The robot can perform the following actions:
- Move(x, y) – Moves the robot from location x to location y if a direct and unobstructed path exists between them, PickUp(p, l) – Picks up package p from location l if the robot is currently at l and p is located there, and DropOff(p, l) – Drops off package p at location l if the robot is currently at l and carrying p .
- (i) Using STRIPS formalism, define the problem by specifying the action schemas for each action. (4 Marks)
(ii) Demonstrate the application of forward chaining to generate a valid action sequence leading to the goal, explicitly updating the state at each step. (6 Marks)

[10] (CO2/K3)

Section - II

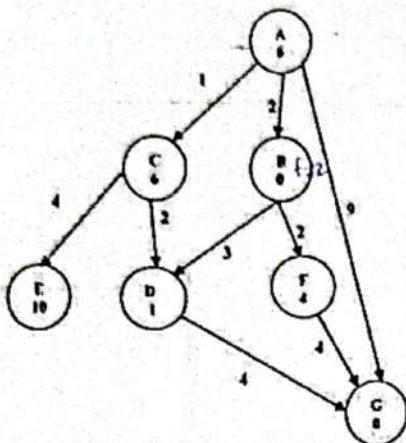
Answer all Questions (4 × 15 Marks)

05. (i) Given the directed graph below, assume Node (1) as the Start Node and Node (10) as the Goal Node. Using this graph, perform a pathfinding search from the Start Node to the Goal Node using both Breadth-First Search (BFS) and Iterative Deepening Search (IDS). For IDS, use a depth limit of 3. If the goal cannot be reached within this limit, explain the outcome and the iterations involved. After executing both searches, Compare their performance based on the number of nodes explored, the depth at which the goal is found, and the overall efficiency in the context of this graph. (7 Marks)



- (ii) A delivery drone must transport a package from the starting location (A) to the delivery point (G) while minimizing energy consumption. The drone operates in an environment with varying terrain difficulty, where path costs represent actual energy consumption due to factors like wind resistance and elevation, while heuristic estimates ($h(n)$) provide an estimated energy cost to reach the goal. The drone navigates through multiple waypoints (B, C, D, E, F) with predefined path costs and heuristic estimates. Using a search technique that

expands the node on the least-cost solution path using estimated cost and actual cost as the evaluation function, determine the most energy-efficient path from A to G. Additionally, analyze the search process by discussing its Time Complexity, Space Complexity, Completeness, Optimality, Advantages, and Disadvantages. (8 Marks)



[15] (CO2/K3)

06. A university is conducting research to understand the factors contributing to a student's happiness. The study considers various traits and behaviors such as creativity, smartness, party activity (social involvement), project involvement, hardware work, MacBook ownership, academic success, and overall happiness. The probabilities associated with these events have been tabulated in conditional probability tables (CPTs). Alex is a student at the university. Based on the given probability data, answer the following questions using the inference by enumeration technique.

Creative	Smart	$P(\text{Project}=\text{T})$
TRUE	TRUE	0.90
TRUE	FALSE	0.40
FALSE	TRUE	0.79
FALSE	FALSE	0.11

Creative	Smart	$P(\text{Mac}=\text{T})$
TRUE	TRUE	0.69
TRUE	FALSE	0.90
FALSE	TRUE	0.41
FALSE	FALSE	0.12

Success	Mac	Party	$P(\text{Happy}=\text{T})$
TRUE	TRUE	TRUE	0.96
TRUE	TRUE	FALSE	0.36
TRUE	FALSE	TRUE	0.72
TRUE	FALSE	FALSE	0.31
FALSE	TRUE	TRUE	0.50
FALSE	TRUE	FALSE	0.21
FALSE	FALSE	TRUE	0.42
FALSE	FALSE	FALSE	0.09

$$P(\text{Creative}) = 0.69, P(\text{Smart}) = 0.71, \\ P(\text{Party}) = 0.60$$

Smart	Party	$P(\text{HW}=\text{T})$
TRUE	TRUE	0.80
TRUE	FALSE	0.90
FALSE	TRUE	0.09
FALSE	FALSE	0.31

Project	HW	$P(\text{Success}=\text{T})$
TRUE	TRUE	0.89
TRUE	FALSE	0.21
FALSE	TRUE	0.31
FALSE	FALSE	0.05

- (i) What is the probability that Alex succeeds academically given that he has completed his project, creative and smart? (5 Marks)
(ii) What is the probability that Alex is happy given that he has succeeded academically and creative, but not smart and doesn't own a MacBook? (5 Marks)
(iii) What is the probability that Alex completes his project given that he is creative, happy, smart, and owns a mac book? (5 Marks)

[15] (CO3/K4)

07. In modern cybersecurity, detecting insider threats is crucial to prevent unauthorized data access and breaches. Logical reasoning and inference mechanisms help identify potential risks and respond proactively. Consider a network that exhibits the following observed facts.

- A user accesses sensitive financial records outside normal working hours.
- The user attempts to disable security monitoring tools.
- There is an unauthorized transfer of confidential files.
- The system logs indicate multiple failed authentication attempts for privileged accounts.
- The user communicates with an external, unverified email address using encrypted messages.

Leveraging comprehensive cybersecurity threat analysis, the following rules are defined:

- If a user accesses sensitive financial records outside working hours and attempts to disable security monitoring tools, then it may indicate insider threat activity.

- If insider threat activity is detected and an unauthorized transfer of confidential files occurs, then the organization's data integrity is at risk.
- If the organization's data integrity is at risk and multiple failed authentication attempts for privileged accounts are observed, then privilege abuse may be happening.
- If privilege abuse is detected and the user is communicating with an external, unverified email using encryption, then a data breach is highly probable.
- If a data breach is highly probable, then an urgent cybersecurity intervention is required to mitigate insider threats.

(i) Apply the Forward Chaining algorithm to determine whether an insider threat has escalated into a data breach requiring immediate cybersecurity intervention. (8 Marks)

(ii) Apply the Backward Chaining algorithm to verify if the observed facts confirm an insider threat leading to a data breach that demands an urgent response. (7 Marks)

[15] (CO3/K4)

08. A research team is working on a text retrieval system that helps in processing and analyzing documents using the TF-IDF algorithm. They have a collection of five short documents related to AI and machine learning: D1: "Natural language processing is in AI", D2: "Deep learning is for natural language" D3: "Machine learning and deep AI are here", D4: "Natural language and machine learning help AI", and D5: "AI is deep in language processing". As part of their evaluation, they need to analyze how well their system ranks documents based on relevance to a given query.

- Compute the Term Frequency for each unique word in every document (After removing stop words, and apply stemming). (4 Marks)
- Compute the Inverse Document Frequency for each unique word. (4 Marks)
- Calculate the TF-IDF score for each document. (4 Marks)
- Based on the TF-IDF scores, determine which document is most relevant to the query "natural language processing" and justify your answer. (3 Marks)

[15] (CO4/K4)

BL-Bloom's Taxonomy Levels - (K1-Remembering,K2-Understanding,K3-Applying,K4-Analysing,K5-Evaluating,K6-Creating)





Final Assessment Test(FAT) - Apr/May 2025

Programme	B.Tech.	Semester	Winter Semester 2024-25
Course Code	BMAT201L	Faculty Name	Prof. Balaji
Course Title	Complex Variables and Linear Algebra	Slot	A2+TA2+TAA2
Time	3 hours	Class Nbr	CH2024250500934
		Max. Marks	100

Instructions To Candidates

Write only your registration number in the designated box on the question paper. Writing anything elsewhere on the question paper will be considered a violation.

Course Outcomes

- CO1: Construct analytic functions and find complex potential of fluid flow and electric fields.
- CO2: Find the image of straight lines by elementary transformations and to express analytic functions in power series.
- CO3: Evaluate real integrals using techniques of contour integration.
- CO4: Use the power of inner product and norm for analysis.
- CO5: Use matrices and transformations for solving engineering problems.

Answer any 10 Questions (10 × 10 Marks)

01. In a two-dimensional fluid flow, the given stream function is $\psi = -\frac{y}{x^2+y^2}$. Find the velocity potential and the corresponding complex potential function $w = \phi + i\psi$. [10] (CO1/K3)
02. Find the bilinear transformation $w = f(z)$ which maps the points $z = 1, i, -1$ onto the points $w = i, 0, -i$. Also, find the fixed points and image of $|z| \leq 1$ under this mapping $w = f(z)$. [10] (CO2/K2)
03. (a). Find all points where the mapping $f(z) = e^{(z^2+\frac{1}{z^2})}$ is conformal. (5 marks)
 (b). Expand the function $f(z) = \frac{1}{(z-1)(z-2)}$ as a Laurent's series valid for i) $1 < |z| < 2$, ii) $|z| > 2$. (5 marks) [10] (CO2/K1)
04. Find the value of the integral $I = \int_0^{2\pi} \frac{1}{13 + 5 \sin \theta} d\theta$ by using contour integration. [10] (CO3/K3)
05. (a). Find the rank of A as a function of x : where $A = \begin{bmatrix} 2 & 2 & -6 & 8 \\ 3 & 3 & -9 & 8 \\ 1 & 1 & x & 4 \end{bmatrix}$. (5 marks)
 (b). Let V be a vector space of all matrices of order n . Suppose W is a space of all diagonal matrices of order n whose traces are zero. Find a basis and the dimension of W . (5 marks) [10] (CO5/K2)
06. Let V be a vector space of all $n \times n$ matrices over \mathbb{R} . Suppose W is a space of all $n \times n$ symmetric matrices whose each column sum is zero. Prove that W is subspace of V . Also, find a basis and the dimension of W . [10] (CO5/K1)
07. Let $T : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ be a linear transformation defined by $T(x_1, x_2) = (x_1 - 2x_2, 2x_1 - 3x_2)$.
 (a). Find the matrix representation of T with respect to the standard basis of \mathbb{R}^2 (5 marks)
 (b). Find the matrix representation of T with respect to the basis $\{(1, -2), (2, 5)\}$ (5 marks) [10] (CO5/K2)
08. Let $T : P_3(\mathbb{R}) \rightarrow M_{2 \times 2}(\mathbb{R})$ be the linear transformation defined by

$$T(a + bx + cx^2 + dx^3) = \begin{bmatrix} a & b + 2d \\ c + 2b & 2a - d \end{bmatrix}$$
, Check whether T is invertible or not. Also, find $T^{-1}\left(\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}\right)$. [10] (CO5/K2)
09. (a). Check whether $\langle (x_1, x_2), (y_1, y_2) \rangle = 3x_1y_1 + 2x_2y_2$ is an inner product on \mathbb{R}^2 or not. (5 marks)

(b). Show that $\langle 3u + 2v, w \rangle = 3\langle u, w \rangle + 2\langle v, w \rangle$ with respect to the above inner product where $u = (1, 2)$, $v = (-1, 0)$, $w = (3, 1)$ (5 marks)

[10] (CO4/K3)

10. Let $W = \{(x, y, z, t) \in \mathbb{R}^4 : x + 2y + z - t = 0\}$, Find the orthonormal basis for W with respect to the standard inner product on \mathbb{R}^4 .

[10] (CO4/K1)

11. Verify the Cayley-Hamilton theorem and hence determine A^{-1} if $A = \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -4 & -3 \end{bmatrix}$.

[10] (CO5/K2)

12. Assume that the equation of the circle $x^2 + y^2 + ax + by + c = 0$ passes through the given three points $(1, 2)$, $(3, 2)$, and $(5, 6)$. Use the Gauss elimination method to find the values of a , b and c , if they exist.

[10] (CO5/K1)

BL-Bloom's Taxonomy Levels - (K1-Remembering, K2-Understanding, K3-Applying, K4-Analysing, K5-Evaluating, K6-Creating)
↔↔↔↔↔



Final Assessment Test(FAT) - Apr/May 2025

Programme	B.Tech.	Semester	Winter Semester 2024-25
Course Code	BCSE302L	Faculty Name	Prof. Sudha
Course Title	Database Systems	Slot	C2+TC2
Time	3 hours	Class Nbr	CH2024250502289
		Max. Marks	100

Instructions To Candidates

- Write only your registration number in the designated box on the question paper. Writing anything elsewhere on the question paper will be considered a violation.

Course Outcomes

- CO1: Comprehend the role of database management system in an organization and design the structure and operation of the relational data model.
- CO2: Develop a database project depending on the business requirements, considering various design issues.
- CO3: List the concepts of indexing and accessing methods.
- CO4: Explain the concept of a database transaction processing and comprehend the concept of database facilities, including concurrency control, backup, and recovery.
- CO5: Review the fundamental view on unstructured data and describe other emerging database technologies.

Section - I

Answer all Questions (4 × 10 Marks)

01. XYZ Corp is a rapidly growing e-commerce company that relies on a large-scale database system to manage customer orders, inventory, and payment transactions. Recently, the company has been facing performance issues — queries are taking too long to execute, reports are generating inconsistencies, and some customer transactions are failing. Some customers are reporting duplicate transactions in their order history. As a Database Administrator how would you investigate and resolve these issues while ensuring data integrity? Illustrate an appropriate architecture for handling the basic functionalities and also accommodating the newly requested features with proper explanation. [4+6 marks] [10] (CO1/K2)
02. a) Check whether the following schedule is recoverable or not. Justify your answer. [4 marks]

Schedule S1:

T1	T2	T3
READ(X)		
X = X+100		
WRITE(X)		READ(Y)
		Y = Y-100
		WRITE(Y)
	READ(X)	
	X = X-20	
	WRITE(X)	COMMIT
FAILURE POINT		
COMMIT	COMMIT	

- b) Consider the following schedule. Check whether the schedule is conflict serializable or not using a precedence graph. If yes, then show all the possible serialization orders of execution. [6 marks]
- S2: R2(Y), R3(Z), W2(Y), R1(X), W3(Z), W1(X), W3(X), R1(Y), W1(Y), R4(A), W4(A); [10] (CO4/K5)

03. Consider the following Voting System Database with two tables:

Voter (VoterID, VoterName, Age, Gender, City, RegisteredDate)

Vote (VoteID, VoterID, CandidateName, Party, ElectionYear, Status, VoteDate)

- i) Create the above tables with the following constraints [5 Marks]

VoterID and VoteID should be Primary Keys. VoterID in Vote should be a Foreign Key referencing VoterID in Voter. Check the Age in Voter should be at least 18 years. Check the ElectionYear should be greater than or equal to 2000. Status in Vote should have a default value of "Pending" if not provided.

- ii) Count the number of voters registered in each city. [1 Mark]

- iii) List the names of candidates who received votes in the current election year. [1 Mark]

- iv) Identify the name of the voter who cast the first vote. [1 Mark]

- v) Create a View named ActiveVoters that contains details of voters who have already voted. [1 Mark]

- vi) Display VoterName, CandidateName, Party, and VoteDate. [1 Mark]

[10] (CO2/K1)

04. A university is designing a library management system to store information such as book details (ISBN, title, author, category, rating) and student details (student ID, name, email ID, department, photo). Books are borrowed by students, and each borrowing transaction records a transaction ID, issue date, due date, and return status.

- a) Discuss how a NoSQL database can be used to develop the above library system. Highlight its suitability, data modeling approach, and advantages over traditional relational databases. [6 marks]

- b) Apply and discuss CAP theorem for the above scenario. [4 marks]

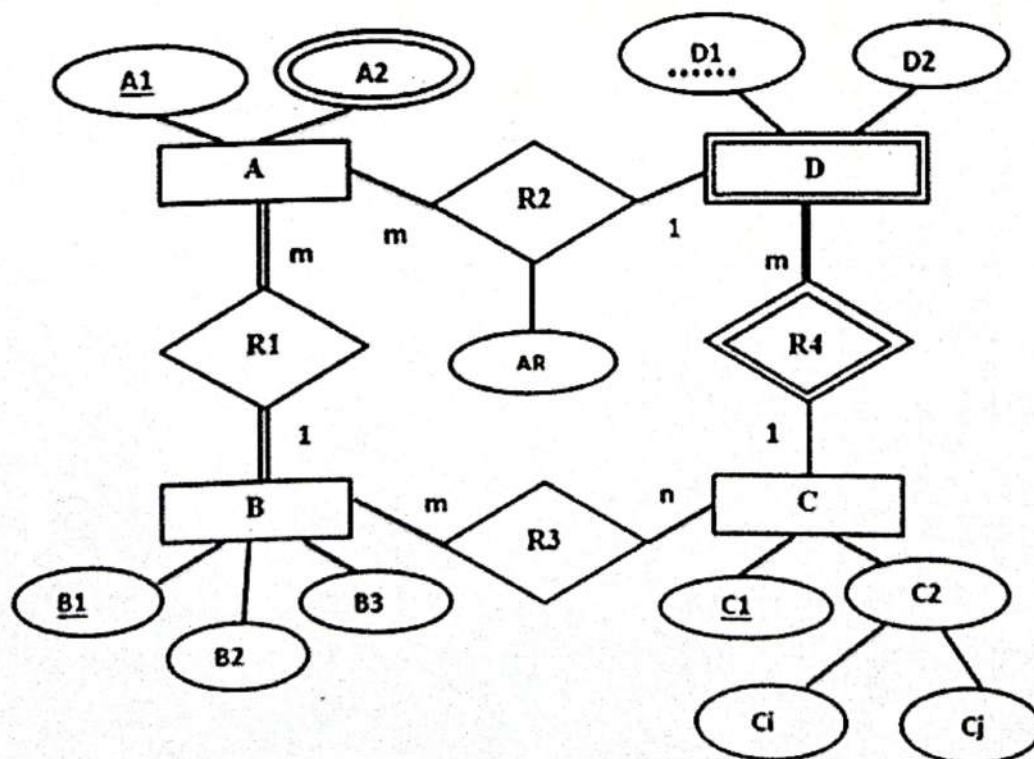
[10] (CO5/K1)

Section - II

Answer all Questions (4 × 15 Marks)

05. a) An E-Commerce Product Review System is built, where buyers can review products sold by different sellers. Each seller has a unique seller ID, seller name and contact email. Products have a product ID, product name, category, price, and description. Buyers must register with a customer ID, customer name, email and registration date. A buyer can write multiple reviews, but each review is linked to one product and one buyer. Reviews include a review ID, rating, comment and timestamp. A product can have multiple reviews from different buyers. Design an Entity-Relationship (ER) diagram for the review system described above, ensuring that all entities, their attributes, relationships, and cardinalities are clearly represented. [8 marks]

b)



Map the above ER model to a relational schema with a step-by-step explanation of each transformation. Include all relevant key constraints, such as primary keys and foreign keys, in your mapping. [7 marks]

06. a) Consider the following relation Rel(TechnicianID, Technician_Name, Attended_Date, Computer_Defect, Defect_Code, Service_Charge). The Functional Dependencies are given below:

$\text{TechnicianID} \rightarrow \text{Technician_Name}$,

$\text{CustomerID} \rightarrow \text{Customer_Name}$,

$\text{TechnicianID}, \text{CustomerID} \rightarrow \text{Customer_Name}, \text{Attended_Date}, \text{Computer_Defect}$

$\text{Computer_Defect} \rightarrow \text{Defect_Code}$

$\text{Defect_Code} \rightarrow \text{Service_Charge}$

i. Identify the candidate key(s). [2 marks]

ii. Which normal form is the current relation in? Justify your answer. [1 mark]

iii. Decompose the relation step by step into BCNF, clearly showing all intermediate tables and dependencies at each stage. [7 marks]

b) Consider the relation R(P,Q,R,S,T). The functional dependencies are defined below:

$P \rightarrow R, PR \rightarrow S, Q \rightarrow PST$.

Find the minimal cover. [5 marks]

[15] (CO2/K4)

07. a) Illustrate an extendible hashing to store the values using bucket size as 2 and the values to insert: {9, 20, 13, 17, 25, 30, 15, 21} [5 Marks]

b) i) Construct a B+ Tree of order 5 for the following sequence of key values: (40, 10, 70, 20, 30, 50, 90, 60, 70, 150, 80, 100, 130, 140) [7 marks]

ii) Delete the keys 60, 50 and 40 from the B+ Tree and illustrate the updated structure after each deletion. [3 Marks]

[15] (CO3/K3)

08. a) Three bank employees are updating the same customer account concurrently. The account initially has a balance of ₹10,000.

- Teller A (T1) processes a deposit of ₹2,000.
- Teller B (T2) processes a withdrawal of ₹1,500.
- Teller C (T3) processes a deposit of ₹1,000.

The operations are interleaved as follows:

Schedule S:

T1	T2	T3
Read(Balance)		
	Read(Balance)	
		Read(Balance)
Balance = Balance + 2000		
	Balance = Balance - 1500	
Write(Balance)		Balance = Balance + 1000
	Write(Balance)	
		Write(Balance)

i) Analyze the above schedule and determine whether it leads to any concurrency-related anomalies. If yes, then identify the type of anomaly with the proper justification. [4 marks]

ii) Apply any mechanism or technique that could prevent this issue in a real-world database system. [2m]

iii) Modify and illustrate the schedule further to ensure cascadeless execution with a proper explanation. [4m]

b) Consider the given schedule with the following transactions that request shared (S) and exclusive (X) locks on various data items. Using a Wait-for Graph, determine whether the execution of the schedule results in a deadlock or not. If yes or no, justify your answer. [5m]

Schedule S1:

Transaction	Lock Acquired	Lock Requested	Notes
T1	S-lock on A	X-lock on B	B is currently S-locked by T2
T2	S-lock on B	X-lock on C	C is currently X-locked by T3
T3	X-lock on C	S-lock on A	A is currently S-locked by T1
T4	S-lock on D	X-lock on A	A is currently S-locked by T1 and also is requested S-locked by T3

[15] (CO4/K5)



Final Assessment Test(FAT) - Nov/Dec 2024

Programme	B.Tech.	Semester	Fall Semester 2024-25
Course Code	BECE204L	Faculty Name	Prof. Ravi Tiwari
Course Title	Microprocessors and Microcontrollers	Slot	G2+TG2
Time	3 hours	Class Nbr	CH2024250100392
		Max. Marks	100

General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Course Outcomes

1. Comprehend the various microprocessors including Intel Pentium Processors
2. Infer the architecture and Programming of Intel 8086 Microprocessor.
3. Comprehend the architectures and programming of 8051 microcontroller.
4. Deploy the implementation of various peripherals such as general purpose input/ output, timers, serial communication, LCD, keypad and ADC with 8051 microcontroller
5. Infer the architecture of ARM Processor
6. Develop the simple application using ARM processor.

Section - I

Answer all Questions (6 × 10 Marks)

Q.No

Question

*M - Marks

*M CO BL

10 2 1

01. Describe the architecture of the 8255 programmable peripheral interface. What are its main components, and how do they work together to facilitate communication between the 8086 microprocessor and peripherals?

10 2 3

02. Write an 8086 assembly language program to count the number of odd and even numbers in a given array of 10 bytes stored in memory. The starting address of the array is 3000H, and the counts of odd and even numbers should be stored at addresses 4000H and 4001H, respectively.

10 3 1

03. Describe the main components of the 8051 architecture, including the CPU, memory (RAM and ROM), and input/output ports. Explain the role of each component in the overall functioning of the microcontroller.

10 3 2

04. (a) Identify the addressing modes employed in the following assembly language instructions for the 8051 microcontroller. (5 Marks)

- (i). SUBB A, B
(ii). MOV @R0, A
(iii). ANL A, #25H
(iv). MOVX A, @DPTR
(v). MOV A, S5H

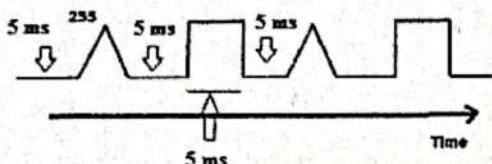
(b) Find the time delay for the following 8051 program, assuming a crystal frequency of 11.0592 MHz. (5 Marks)

INSTRUCTION	MACHINE CYCLE
MOV R2, #250	1
HERE: NOP	1
NOP	1
NOP	1
DJNZ R2, HERE	2
RET	2

Timin 0, mode 2
1253 (01253)

- Q5. Write an 8051 Assembly Language Program to generate a periodic waveform with a proper time interval as given below using DAC, assuming a crystal frequency of 11.0592 MHz.

10 5 5



- Q6. In the table below, fill in the contents of each register after the execution of every ARM instruction in the following program. The initial values of the registers are given. Apply the updated register values for the next operation.

10 6 2

Line number	Instructions	Initial Values of Registers			
		r1	r2	r3	r4
		0000000A	00000015	00000065	00000074
Line Num:1	ADD r1, r2, r4, LSR #2				
Line Num:2	MLA r1, r2, r3, r4				
Line Num:3	MOV r1, r2, ASR #2				
Line Num:4	BIC r1, r2, r3				
Line Num:5	ADDS r4, r2, r0				

Section - II Answer all Questions (2 × 20 Marks)

*M - Marks

- | Q.No | Question | *M CO BL |
|------|--|----------|
| Q7. | Write an assembly language program for an 8051 microcontroller-based system designed for a Smart Library Entrance. The system should continuously transmit the message "WELCOME TO THE LIBRARY" serially to a connected monitor at a baud rate of 9600, assuming a crystal frequency of 11.0592 MHz. Additionally, a laser transmitter and receiver unit should be installed at the entrance of the library to monitor and detect the entry of library users, with the laser receiver connected to the INT0 pin (P3.2) of the 8051 microcontroller. When a user enters the library, triggering an interrupt signal, the microcontroller should count the number of individuals entering inside the library | 20 4 5 |
| Q8. | (a) Explain the ARM register set in detail, highlighting the purpose of each type of register. Furthermore, describe the different operating modes of an ARM processor and discuss how the register set varies across these modes. (15 marks)

(b) Suppose you wish to design a system that has different paths for data and instructions and is capable of executing multiple instructions and data at the same time, what kind of architecture would you use, and why? Explain the process with its architecture diagram. (5 marks) | 20 1,5 2 |

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating,

6.Creating)



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Final Assessment Test(FAT) - Nov/Dec 2024

Programme	B.Tech.	Semester	Fall Semester 2024-25
Course Code	BCSE202L	Faculty Name	Prof. Ilavendhan A
Course Title	Data Structures and Algorithms	Slot	E2+TE2
Time	3 hours	Class Nbr	CH2024250100820
		Max. Marks	100

General Instructions

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Course Outcomes

- Understand the fundamental analysis and time complexity for a given problem.
- Articulate linear, non-linear data structures and legal operations permitted on them.
- Identify and apply suitable algorithms for searching and sorting.
- Discover various tree and graph traversals.
- Explicate hashing, heaps and AVL trees and realize their applications.

Section - I Answer all Questions (7 × 10 Marks)

*M - Marks

Q.No	Question	*M - Marks		
		*M	CO	BL
01.	<p>Hema, a data analyst at a large e-commerce company, generates daily reports by sorting customer orders based on attributes like order date and total value. She needs to sort the orders by order date first, and for orders with the same date, by total value in ascending order. Given the following customer orders (with sample order dates and total values):</p> <ol style="list-style-type: none"> Order Date: 2023-01-15, Total Value: 12 Order Date: 2023-01-14, Total Value: 10 Order Date: 2023-01-15, Total Value: 8 Order Date: 2023-01-13, Total Value: 3 Order Date: 2023-01-14, Total Value: 43 Order Date: 2023-01-12, Total Value: 15 Order Date: 2023-01-13, Total Value: 35 Order Date: 2023-01-12, Total Value: 25 Order Date: 2023-01-15, Total Value: 68 <p>Sort the given data by using the <u>QuickSort algorithm</u>. Assume that the order date is the primary sorting attribute and total value is used as a secondary sorting attribute in case of ties. For comparison of dates, assume that the function <u>isDateGreater Than(date1, date2)</u> exists and returns true if date1 is later than date2, and false otherwise. Write down the recurrence relation for the sorting algorithm and derive its time complexity.</p>	10	3	4

02. a) Analyze the function provided below and derive its time complexity using an substitution method. Illustrate your approach and show each step in detail. (6 Marks)

```
int add(int n)
{
    if (n <= 1)
        return 1;
    int x = add(n / 4) + add(n / 4) + add(n / 4) + add(n / 4);
    for (int i = 0; i < n; i++)
    {
        for (int k = 0; k < n; k++)           ~
        {
            for (int j = n; j > 1; j /= 2)   n · n · log n
            {
                printf("%d ", i);
            }
        }
    }
    return x;
}

int main()
{
```

int n = 16;
 printf("Result: %d\n", add(n));
 return 0;
}

- b) Given the following C function that evaluates a computational task:

```
int T(int n, int m) {
    for j = 1 to m
    {
        int result = 0;
        while (n > 1)
        {
            result = result + n / 2;
            n = n / 3;
            result = result + 3 * (n / 2);
        }
    }
    if (n <= 1)
        result = result + 1;
    return result;
}
```

Derive the number of step counts for each operation and determine the resulting time complexity. (4 Marks)

- Q3. a) Vinay is designing a tool that converts infix circuit expression to prefix form for easy evaluation. Prefix expression notation requires that all operators precede the two operands that they work on. Show the conversion process and provide pseudocode. (6 Marks)

The expression is : = A % B ^ C * D + (E - F) * G ^ H

- b) Evaluate the prefix expression (resulted from above question) and show all intermediate steps and calculations. (4 Marks)

Where as: A=4, B=2, C=2, D=10, E=6, F=3, G=2, H = 2.

- Q4. Given a binary tree and an integer targetSum, we want to count the number of paths in the tree where the sum of the node values along each path equals targetSum. A path must move downward, meaning each path must go from a parent node to its child nodes, but can start and end at any node in the tree.

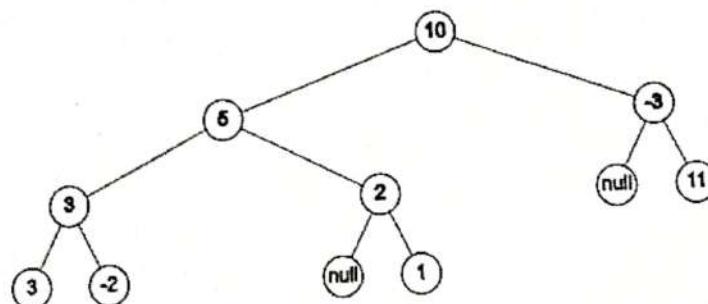
Input: targetSum = 8

Output:

5 - 3

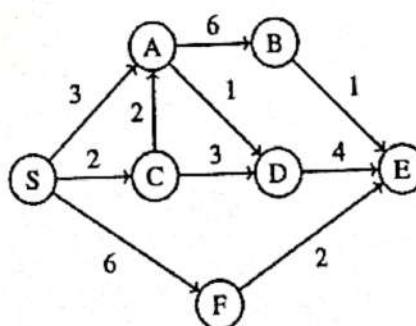
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-3 - 11



Write an algorithm to count the number of paths in the tree such that the sum of the node values along each path equals targetSum.

- Q5. A logistics company aims to optimize its delivery times by determining the shortest routes from its central warehouse, labeled as 'S', to various delivery zones labeled as '{A, B, C, D, E, F}'. Each route between zones is represented by a directed edge with a weight corresponding to the travel time. The delivery route distances between zones are provided as follows:



- a) Develop a pseudocode using an appropriate algorithm to find the shortest paths from warehouse 'S' to each of the delivery zones '{A, B, C, D, E, F}'. (5 Marks)
- b) Apply the selected algorithm to compute and present the shortest delivery times from warehouse 'S' to each delivery zone '{A, B, C, D, E, F}'. Provide a detailed explanation of the results, describing how the shortest paths and delivery times were calculated. (5 Marks)

06.

Given the following set of integers: {4371, 1323, 6173, 4199, 4344, 9679, 1989, 2567, 3302, 7021}, and using the hash function $h(X) = (X \% 100) \text{ mod } 13$.

a) Construct a hash table using "separate chaining" for collision resolution. Illustrate the resulting table, clearly show how collisions are handled by chaining values at the same index. (5 Marks)

b) Construct a hash table using "open addressing with quadratic probing" for collision resolution. Provide a detailed representation of the hash table, illustrating how each value is placed and how collisions are resolved during the insertion process. (5 Marks)

07.

A logistics network connects Mumbai to various nearby cities, each with unique travel times. To efficiently manage this network, you need to organize the cities in an AVL tree based on their travel times from Mumbai, allowing quick access to the closest and farthest cities. The initial travel times to the cities are : 25, 15, 30, 50, 60, 10, 35.

a) Construct an AVL tree by inserting each travel time sequentially, and calculate the balance factor after each insertion. (5 Marks)

b) Perform three deletions on travel times '30', '10', and '50', demonstrate the rebalancing steps in the AVL tree after each deletion. (5 Marks)

Section - II

Answer all Questions (2 × 15 Marks)

*M - Marks

Q.No	Question	*M	CO	B
08.	<p>a) You are given two doubly linked lists, List1 and List2, each containing unique integers sorted in ascending order. Write a function, mergeSortedLists(List1, List2), to merge these two lists into a new doubly linked list that maintains sorted order without introducing any duplicate values. In your function, ensure that both List1 and List2 are traversed efficiently to build the merged list in optimal time. Finally, analyze and discuss the time complexity of your solution. (8 Marks)</p> <p>Example:</p> <ul style="list-style-type: none"> • List1 contains: 1 <-> 3 <-> 5 <-> 7 • List2 contains: 2 <-> 3 <-> 6 <-> 8 • Merged List: 1 <-> 2 <-> 3 <-> 5 <-> 6 <-> 7 <-> 8 <p>b) A queue using a singly linked list that supports two modes of operation: insertion at the front with deletion at the rear, and insertion at the rear with deletion at the front. Provide an algorithm for both modes and analyze the time complexity for each operation in both cases. (7 Marks)</p>	15	2	4
09.	<p>Given the string "COMPUTER", you need to complete the following tasks:</p> <p>a) Construct the BST by inserting each character in the order provided, ensuring the BST properties are maintained. (4 Marks)</p> <p>b) Write a function to perform an in-order traversal of the tree. (2 Marks)</p> <p>c) Write a non-recursive algorithm to find the height of the BST. (4 Marks)</p> <p>d) Write an algorithm to delete a search node that has both the left and right subtrees in a BST. (5 Marks)</p>	15	4	

BL-Bloom's Taxonomy Levels - (1.Remembering, 2.Understanding, 3.Applying, 4.Analysing, 5.Evaluating, 6.Creating)

