



**VIT**

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

Reg. Number: 23BAE1063

Continuous Assessment Test(CAT) – I-January 2024

Programme :	B.Tech	Semester	:	Win-24-25
Course Code & Course Title :	BMAT201L & Complex Variables and Linear Algebra	Slot	:	A2+TA2+TA A2
Faculty :	Dr. R. Jayagopal, Dr. S. Balaji, Dr. A. Manivannan, Dr. Amit Kumar Rahul, Dr. P. Vijay Kumar, Dr. P. Durgaprasad, Dr. R. Pavithra, Dr. C. Rajivganthi, Dr. Prosenjit Paul	Class Numbers	:	CH20242505 00933, 934, 936, 937, 938, 939, 940, 941, 942
Duration :	1 hour 30 Mins	Max. Mark		50

**General Instructions:**

- Write only your registration number on the question paper in the box provided and do not write other information
- Only non-programmable calculator without storage is permitted

**Answer all questions**

Q. No	Sub Sec.	Description	Marks
1		Find the analytic function of $f(z) = u + iv$ , where $2u + v = \frac{\cos x + \sin y - e^{-y}}{2 \cos x - e^y - e^{-y}}$ .	10
2		Show that $f(z) = \begin{cases} \frac{z^5}{ z ^4}, & z \neq 0 \\ 0, & z = 0 \end{cases}$ satisfied the Cauchy-Riemann equations at $z = 0$ . Also, show that the derivative of $f(z)$ does not exists at $z = 0$ .	10
3		If $u_1(x, y) = \ln(x^2 + y^2)$ is harmonic (here, $(x, y) \neq (0, 0)$ ) and $u_2(x, y) = x^2 - y^2$ is harmonic. Make use of harmonic condition, verify whether $v = u_1(x, y) + u_2(x, y)$ is harmonic or not.	5
4	a	Find a bilinear transformation that maps the vertices $1+i, -i, 2-i$ of a triangle $T$ of the $z$ plane into the points $0, 1, i$ of the $w$ plane.	5
4	b	Find the image of $ z  \leq 1$ under the mapping $w = \frac{z-4}{z+1}$ and hence find the fixed points of the transformation. Also sketch the region.	5
5	a	Prove that the mapping $w = 2e^{5z} + 5$ is conformal everywhere in the finite complex plane and hence find the image of the $1 \leq x \leq 4$ and $\pi \leq y \leq 3\pi/2$ under the mapping $w = e^z$ .	5



## Continuous Assessment Test 1 (CAT 1) - January 2025

Programme	:	B.Tech (CSE)	Semester	:	Winter Semester 2024-25
Course Code & Course Title	:	BCSE302L & Database Systems	Slot	:	C2+TC2
Faculty	:	Dr. A MURALIDHAR Dr. S.GAYATHRI DEVI Dr. A.BALASUNDARAM Dr. K.PARKAVI Dr. AMRIT PAL Dr. ABISHI CHOWDHURY Dr. VIJAYAKUMAR K P Dr. S.BRINDHA Dr. A.SUDHA	Class Number	:	CH2024250501761 CH2024250502077 CH2024250502079 CH2024250502082 CH2024250502217 CH2024250502221 CH2024250502224 CH2024250502227 CH2024250502289
Duration	:	1 1/2 Hours	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

**Answer all questions**

Q. No	Part A (5 X10 = 50) Marks	Marks
1	<p>a) A bank operates multiple branches where customers frequently perform transactions simultaneously. However, the existing file-based system occasionally experiences data overwrites when two users access the same file concurrently. As the banking system manager, what solution would you propose to ensure seamless concurrent access? Identify the architecture to support the given scenario. (5 marks)</p> <p>b) Compare and contrast the database management system with traditional file system. (5 marks)</p>	10
2	Assume you are working in a software company responsible for creating and maintaining a large database to manage critical business data, including employee records, project details, client information, and financial transactions. Your role involves designing, implementing, and managing the database architecture to ensure scalability, efficiency, and security. Identify and discuss an appropriate schema architecture for this scenario, outlining its components and providing a suitable diagram to illustrate the structure and relationships within the database.	10
3	<p>Write SQL statements for the following questions.</p> <p>i. Create a table named Restaurant with the following fields</p> <p>RESTAURANT(FoodID, FoodName, Category, Price_INR, Availability)</p> <p>In this table Category takes the values Veg / Non-Veg and Availability takes the values Yes / No. While creating the table the following restrictions need to be considered. FoodID should be unique and should not be null. FoodName should not be null or empty. Price will be a number with max value 999.99. Availability should be defaulted to Yes. [4 marks]</p>	10

ii. List all the food names starting with the letter P. [2 marks]

iii. List the average price of vegetarian food that is available. [2 marks]

iv. List the FoodID and FoodName of all the food items whose price range is between 400 to 500. [2 marks]

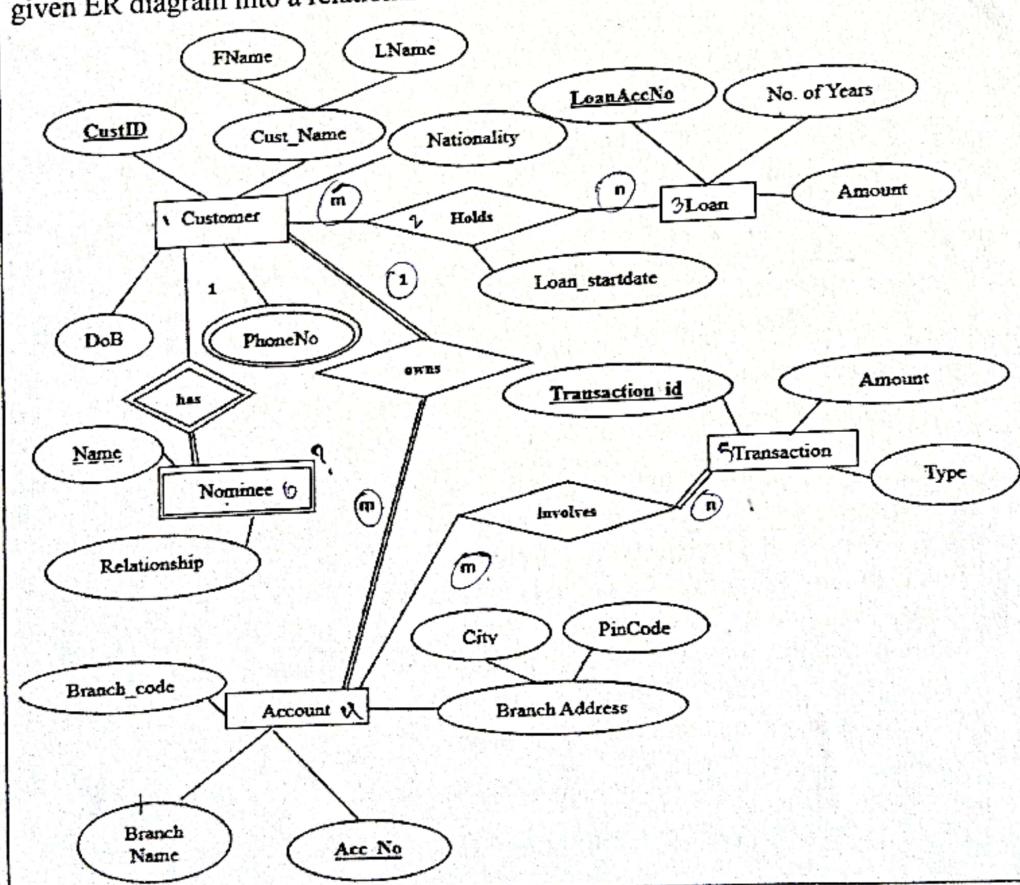
4

Design an Enhanced Entity Relationship (EER) Diagram for the given scenario. Identify and list out the entities, attributes, relationships and EER features and include the same in diagram. Consider car rental management system, where cars are identified by unique CarID and have other attributes like Name, Model, Year, Price, etc. and cars are categorized into luxury and economy cars with their own attributes. Customers are identified by Customer ID and has other attributes like name, mailid, phone number, etc. and are categorized as individual customers and corporate customers with its own attributes. Rentals information is identified by RentalID, and includes other attributes like Rentaldate, return date, price and paymentstatus. A rental record is related to one car and one customer. A car can be rented many times and a customer can have many rentals. Payment details are identified by payment ID, date, amount and paymentmode. Each payment record is associated with only one rental and vice versa. Location details are identified by attributes like LocationID, address. Cars are stored in a location and each location can have many cars. Rental pick up and return can be at different locations.

10

relations

5

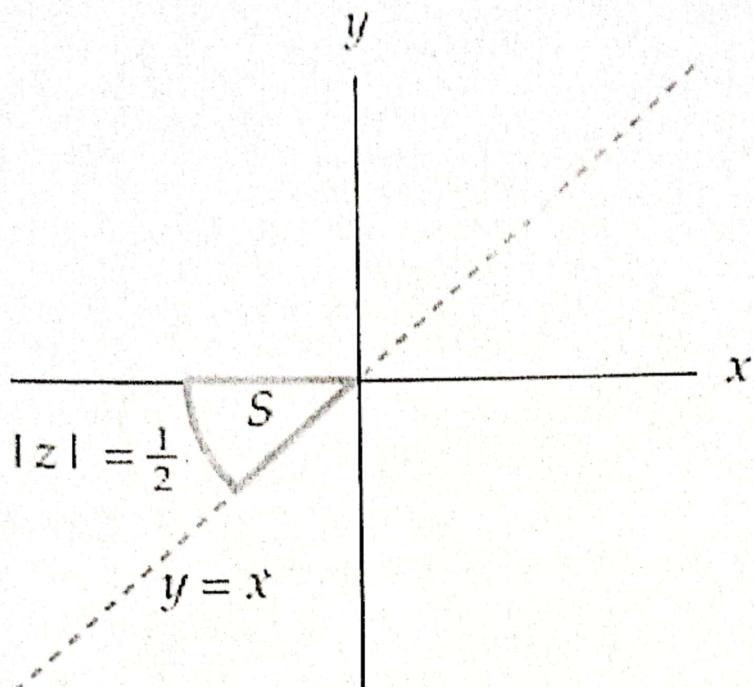


10

*O x axis*  
Find and sketch the image of the region  $S$  plotted below under the mapping  $w = \frac{1}{z}$  on the extended complex plane.

5 b

5



6

Obtain the Taylor Series expansion of  $f(z) = e^z$  about the point  $z = 2$ . Also, find the radius of convergence of the power series at  $z = 2$ .

5



**VIT**

Vellore Institute of Technology  
The Society for Education, Science and Technology Act, 1996  
CHENNAI

Reg. Number	
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### Continuous Assessment Test I – Jan 2025

Programme	: B.Tech. CSE and Specialization	Semester	: Winter 24-25
Course Code & Course Title	: BCSE306L & Artificial Intelligence	Slot	: F2+TF2
Faculty (s)	: Dr.K.Tamilarasi Dr. Modigari Narendra	Class Nbr(s)	: CH2024250502324 CH2024250502335
Time	: 1 ½ Hours	Max. Marks	: 50

#### General Instruction:

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

#### Answer ALL Questions

Q.No	Question Description	Marks
1	<p>1. A smart farming company wants to develop an AI-based crop health monitoring agent. The agent should monitor environmental conditions, detect plant diseases from images, and provide recommendations to optimize crop yield. It will use real-time sensor data and image recognition to analyze plant health and suggest actions like irrigation or pest control.</p> <p>(i) Describe the PEAS description for this AI-based crop health monitoring agent. (7 Marks)</p> <p>(ii) Suggest a suitable intelligent agent type for this application. Justify your recommendation and explain how it would operate with a supporting diagram. (8 Marks)</p>	15
2	<p>2 Anne is a robotics engineer working on a part-picking robot for an automated warehouse. The robot's job is to find specific items from storage bins or shelves and take them to packing areas. In the warehouse, the robot needs to move through narrow paths without bumping into things like moving carts or other robots. Sometimes, the warehouse layout or item locations change, so the robot must adjust to new conditions. The robot also handles different types of items, some of which are delicate or heavy, using special grippers and sensors to avoid damage.</p> <p>Identify seven types of task environments of an intelligent agent. Characterise the seven types of task environments in detail for warehouse automation with a part-picking robot explanations.</p>	10
3	<p>3 The Water Jug Problem involves two unmarked jugs: one with a capacity of 3 litres and the other with a capacity of 5 litres. Using a pump to fill the jugs, the challenge is to measure exactly 4 litres of water in the 5-litre jug. Starting with both jugs empty, the goal is to determine a sequence of steps to achieve this target.</p> <p>(i) Explain DFS and IDS algorithms with specified limit = 4, and analyze Time Complexity, Space Complexity, Completeness, and Optimality. (10 Marks)</p> <p>(ii) Compare the advantages and disadvantages of DFS and IDS algorithm.(5 Marks)</p>	15
4	<p>4 John is planning a trip across a country with several towns connected by roads of varying lengths. Each town is represented as a vertex and the distances between the towns vary. John's goal is to travel from town A to town G, using two cost functions: G(n) representing the distance between towns and H(n) represents the straight-line distance</p>	

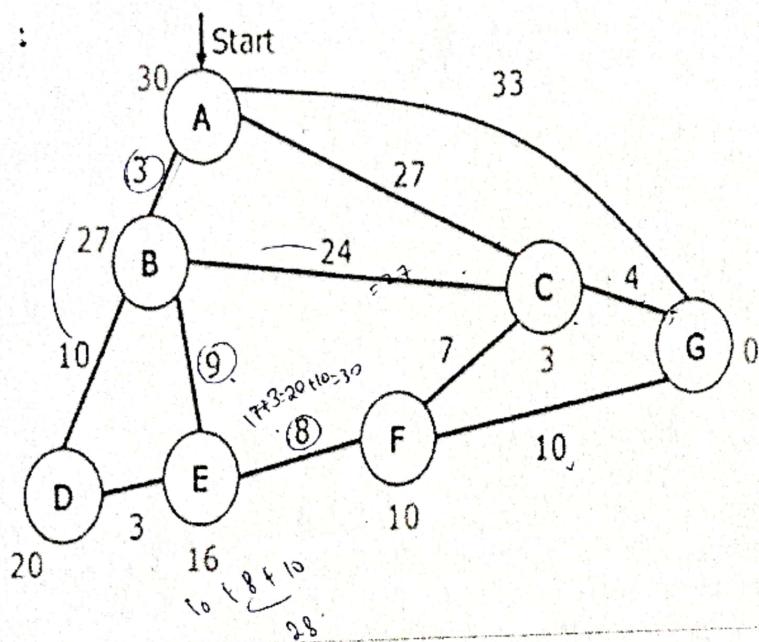
from town A to town G. Using these cost functions, the task is to determine the optimal path from town A to town G with two search techniques:

i) Search technique by expanding the node closest to the goal state using estimated cost as the evaluation (5 Marks)

ii) Search technique by expanding the node on the least cost solution path using estimated cost and actual cost as the evaluation function. (5 Marks)

Illustrate step-by-step the path you would take from town A to town G, considering both techniques. Additionally, you need to justify which approach would be the best for finding the optimal path and explain your reasoning.

10





**Continuous Assessment Test-1 – January 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. During a placement discussion the interviewer has given you a challenge, answering which will land you a super dream job offer. The challenge is to describe some of the challenges of designing operating systems for mobile devices compared with designing operating systems for traditional PCs. Justify your choice of the structuring approach to design and implement the operating system for mobile devices. [10]
2. Design a multithreaded C program to process a list of integers (10, 7, 8, 6, 4, 9, 3, 12, 5, 8, 15, 2, 10, 14, and 6). The program should achieve two objectives concurrently using threads:
- Task 1: Identify and store all valley numbers in the list. A valley number is a number smaller than or equal to both its preceding and succeeding neighbours, excluding the first and last elements of the list. [5 marks]
  - Task 2: Identify the pair of even numbers in the list that has the largest sum, without using sorting to find the pair.[5 marks]
3. a) Write the output of the following Program and justify it using a process tree. [5 marks]
- ```
#include <stdio.h>
#include <unistd.h>
int main()
{
    if(fork()) {
        if(!fork()) {
            fork();
            printf("1 ");
        }
        else {
            printf("2 ");
        }
    }
    else {
        printf("3 ");
    }
    printf("4 ");
    return 0;
}
```
- b) Write two C programs named ‘program1.c’ and ‘program2.c’. In program1.c, the program should print its own process ID (PID) and use an appropriate system call to

execute the code in program2.c. The program2.c should print its own process ID (PID). After executing program1.c, discuss its output, whether the process ID (PID) of program2.c is the same as or different from program1.c, and justify your answer. [5 marks]

4. A smart city uses an automated traffic management system to control traffic lights, manage emergency vehicle routes, and process pedestrian crossing requests. The system must prioritize tasks based on their urgency and ensure smooth traffic flow. The tasks include, Emergency Vehicle Routes, Regular Traffic Lights, and Pedestrian Crossing Requests. The system must decide how to schedule these tasks to avoid delays and ensure fairness. The following table provides task details. [10]

| Task ID | Arrival Time (ms) | Duration (ms) | Urgency Level (1 = Highest Priority) |
|---------|-------------------|---------------|--------------------------------------|
| T1      | 0                 | 10            | 1                                    |
| T2      | 1                 | 20            | 3                                    |
| T3      | 2                 | 5             | 2                                    |
| T4      | 3                 | 15            | 2                                    |
| T5      | 4                 | 30            | 3                                    |

- a) Identify the most appropriate scheduling strategy to manage the tasks efficiently. Calculate the Average Waiting Time, Average Turnaround Time and provide the Gantt chart showing the order of task execution for your chosen scheduling algorithm. [7 Marks]
- b) How can the system handle the delay of low priority tasks when there are continuous high priority task requests are received in large numbers? [3 marks]
5. At a popular gaming arcade, there is a Virtual Reality (VR) experience booth that is in high demand. To ensure fairness and prioritize certain players, the arcade manager implements the following rules for scheduling: [10]
- a) Each player gets a maximum of 10 minutes to use the VR booth at a time (time quantum).
  - b) If a player's game session is not completed within their 10-minute time slice, they must re-join the queue and wait for their next turn.
  - c) Players are served in the order they arrive, but VIP players are given higher priority and allowed to cut ahead in the queue.
  - d) Among players with the same priority, the time slice rule and arrival order still apply.

The VR experience has varying session lengths depending on the game selected by each player. Adventure Quest: 25 minutes Space Battle: 15 minutes Mystery Island: 40 minutes

| Player ID | Game Selected   | Arrival Time (minutes) | VIP Status (Yes/No) |
|-----------|-----------------|------------------------|---------------------|
| P1        | Adventure Quest | 0                      | No                  |
| P2        | Space Battle    | 5                      | Yes                 |
| P3        | Mystery Island  | 10                     | No                  |
| P4        | Adventure Quest | 12                     | Yes                 |

Using the rules mentioned above, determine:

1. The order in which players will use the VR booth. [6 marks]
2. The completion time, turnaround time and the waiting time for each player. [2 marks]
3. Average turnaround time and average waiting time of all players [2 marks]



## Continuous Assessment Test(CAT) – I - FEB 2024

|                            |   |                                                                                                                                                                                            |              |   |                                                                                                                                                                         |
|----------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Programme                  | : | B.Tech(BCE, BRS, BAI, BDS, BLC)                                                                                                                                                            | Semester     | : | Winter 2023-2024                                                                                                                                                        |
| Course Code & Course Title | : | BCSE102L - Structured and Object-Oriented Programming                                                                                                                                      | Slot         | : | B2                                                                                                                                                                      |
| Faculty                    | : | Dr.Mansoor Hussain D<br>Dr.Amutha S<br>Dr. Indra Priyadarshini<br>Dr.Suguna<br>Prof.Balaji V<br>Prof. Rajathi C<br>Prof.Pankaja Lakshmi P<br>Dr. Manas Ranjan Prusty<br>Dr.J.Uma Maheswari | Class Number | : | CH2023240501318<br>CH2023240501320<br>CH2023240501322<br>CH2023240501325<br>CH2023240501328<br>CH2023240501332<br>CH2023240501340<br>CH2023240501349<br>CH2023240501378 |
| Duration                   | : | 1 Hour 30 Mins                                                                                                                                                                             | Max. Mark    |   | 50                                                                                                                                                                      |

**General Instructions:**

- Write only your registration number on the question paper in the box provided and do not write other information.
- Only non-programmable calculator without storage is permitted

**Answer all questions**

| Q. No | Sub Sec. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Marks |
|-------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1.    |          | <p>Imagine that you are a software developer working for a credit card company tasked with automating the monthly billing process. Write a C program to <u>read the customer's data</u> such as <u>opening balance (OB)</u>, <u>payments (P)</u>. Determine and <u>print the updated balance (UB)</u> by <u>deducting payments (P)</u>, and <u>adding interest amount (I = 0.02% on the OB)</u> for <u>n customers</u>. The formula to calculate UB is given below.</p> $UB = OB - P + I$                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 10    |
| 2.    |          | <p>A merchant decides to sell his goods online through a portal which is spread across India. Write a C program to validate the location code in order to check if the goods can be delivered to the customer's location or not, using a Look-up list (CHN-Chennai, BGL-Bangalore, DEL-Delhi, HYD-Hyderabad, KLA-Kerala) and the validation rules are given below. Print an appropriate message if the location code is valid/invalid. Following are the validation rules:</p> <ol style="list-style-type: none"> <li>Ensure the location code provided is not having any special characters. [3 Marks]</li> <li>Automatically convert the location code to uppercase. [2 Marks]</li> <li>Ensure the location code provided is exactly 3 characters long as mentioned in the Look-up list given above. [2 Marks]</li> <li>Ensure the location code provided is one of the top 5 branch codes based on the Look-up list given above. [3 Marks]</li> </ol> | 10    |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |     |     |      |      |      |     |     |      |   |     |     |     |     |     |      |     |     |     |      |    |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|------|------|-----|-----|------|---|-----|-----|-----|-----|-----|------|-----|-----|-----|------|----|
| 3.  | <p>The function <code>ParkingFee</code> has the following two parameters:</p> <ul style="list-style-type: none"> <li>(i) Type of the vehicle, (<code>vehicleType = 'M'</code> for Motorbike, '<code>C</code>' for Car, '<code>B</code>' for Bus, and '<code>V</code>' for Van);</li> <li>(ii) Number of hours (parking hours) that a vehicle was parked in the parking lot.</li> </ul> <p>The function should return the parking charge based on the following rates: Rs. 50, Rs. 80, Rs. 100 and Rs. 120 per hour for Motorbike, Car, Bus and Van respectively.</p> <p>After the calculation of parking charge, the discount is given to those who parked for a longer time. The discount rate is as follows. If the parking charge <math>\leq</math> Rs. 300, then no discount. If the parking charge is between Rs. 301 to Rs. 700 then 10% discount otherwise 30% discount.</p> <p>Write a C program to read the values for type of vehicle and the parking hours from the user and to display the parking charge by using <code>ParkingFee()</code> function.</p>                      | 10  |     |     |      |      |      |     |     |      |   |     |     |     |     |     |      |     |     |     |      |    |
| 4.  | <p>a Write a single C program to perform the below tasks(a,b,c). In this, you take the number of integers (<code>size</code>) from the user that you would be working on along with the integers as input from the user. These integers are stored in an array named <code>numArray</code>. It is assumed that this array contains unique positive and negative numbers excluding zero. [2 marks]</p> <p>b Arrange the array in such a manner that all negative numbers are in the left of the array and all positive numbers are in the right of the array. Print the array after segregation [4 marks]</p> <p>c Upon segregation, print the consecutive pair of numbers in the positive section that sums up to 9 and the consecutive pair of numbers in the negative section that sums up to -9. If no such pair exists in either of the section then print "Pair does not exist".</p> <p>[4 marks]</p>                                                                                                                                                                                  | 10  |     |     |      |      |      |     |     |      |   |     |     |     |     |     |      |     |     |     |      |    |
| 5   | <p>Write the C program to store image of size <math>3 \times 3</math> with its pixels in 1D array, each of length 4bytes. Get the input(pixels) from the user.</p> <p>Perform the following task with pointer variables and also allocate the memory dynamically.</p> <ul style="list-style-type: none"> <li>(i) Store the elements in a 1D array with a contiguous memory location.</li> <li>(ii) Insert the sum of the first and last pixel values as the first value in the same 1D array.</li> <li>(iii) Add the product of the first and last pixel values as the last element of the same array. Display the new pixel values.</li> </ul> <p>Sample value for one image.</p> <table border="1" data-bbox="309 1785 928 1830"> <tr> <td>1.2</td><td>1.4</td><td>2.3</td><td>1.6</td><td>1.5</td><td>34.2</td><td>3.6</td><td>4.5</td><td>5.8</td></tr> </table> <p>output</p> <table border="1" data-bbox="309 1920 976 1954"> <tr> <td>7</td><td>1.2</td><td>1.4</td><td>2.3</td><td>1.6</td><td>1.5</td><td>34.2</td><td>3.6</td><td>4.5</td><td>5.8</td><td>6.96</td></tr> </table> | 1.2 | 1.4 | 2.3 | 1.6  | 1.5  | 34.2 | 3.6 | 4.5 | 5.8  | 7 | 1.2 | 1.4 | 2.3 | 1.6 | 1.5 | 34.2 | 3.6 | 4.5 | 5.8 | 6.96 | 10 |
| 1.2 | 1.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2.3 | 1.6 | 1.5 | 34.2 | 3.6  | 4.5  | 5.8 |     |      |   |     |     |     |     |     |      |     |     |     |      |    |
| 7   | 1.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.4 | 2.3 | 1.6 | 1.5  | 34.2 | 3.6  | 4.5 | 5.8 | 6.96 |   |     |     |     |     |     |      |     |     |     |      |    |

\*\*\*\*\* All the best \*\*\*\*\*



**VIT**  
Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)  
CHENNAI

Reg. Number: 23BAI1489

### Continuous Assessment Test (CAT) – I AUGUST 2024

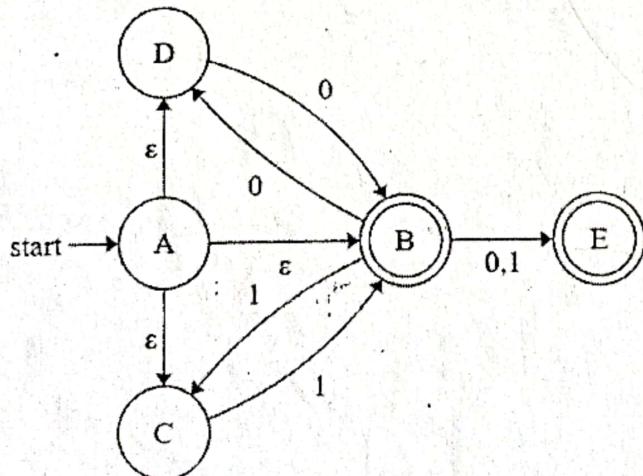
|                            |   |                                                   |              |   |                                                         |
|----------------------------|---|---------------------------------------------------|--------------|---|---------------------------------------------------------|
| Programme                  | : | BTech Computer Science and Engineering            | Semester     | : | FALL 24-25                                              |
| Course Code & Course Title | : | BCSE304L THEORY OF COMPUTATION                    | Class Number | : | CH2024250100534,<br>CH2024250101447,<br>CH2024250100912 |
| Faculty                    | : | Dr. S Kiruthika, Dr. Anand M,<br>Dr. Nathezhtha T | Slot         | : | A2+TA2                                                  |
| 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.
- Use statistical tables supplied from the exam cell as necessary
- Use graph sheets supplied from the exam cell as necessary
- Only non-programmable calculator without storage is permitted

**Answer all questions**

| Q. No | Description                                                                                                                                                                                                                                                                                                                                                                         | Marks |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1.    | <p>a) Construct the deterministic finite automaton for a language over the <math>\Sigma = \{a,b\}</math>, which accepts all strings that begin and end with different symbol. (5 Marks)</p> <p>b) Construct the deterministic finite automaton for a language over the <math>\Sigma = \{0,1\}</math>, for all strings in which the number of zeros is divisible by 4. (5 Marks)</p> | 10    |
| 2.    | Convert the given $\epsilon$ -NFA into NFA without $\epsilon$ moves with necessary steps.                                                                                                                                                                                                                                                                                           | 10    |
| 3.    | <p>Construct the finite automaton for the following languages</p> <p>a) <math>L_1 = \{w \mid w \in \Sigma^* = \{a,b\}^*, \text{ where } w \text{ contains the strings starting with}</math></p>                                                                                                                                                                                     | 10    |



$aabb\}.$  (2.5 Marks)

- b)  $L_2 = \{w \mid w \in \Sigma^* = \{a,b,c\}^*, \text{ where } w \text{ contains strings where third symbol from right is } a, \text{ second symbol from right is } b \text{ and first symbol from right is } c\}.$  (2.5 Marks)
- c)  $L_3 = \{w \mid w \in \Sigma^* = \{a,b\}^*, \text{ where } w \text{ contains the strings which ends with two consecutive } a's \text{ or two consecutive } b's\}.$  (2.5 Marks)
- d)  $L_4 = \{w \mid w \in \Sigma^* = \{a,b\}^*, \text{ where } w \text{ does not contains the strings which ends with } ab\}.$  (2.5 Marks)

4.

You are designing a search engine feature that filters the queries based on certain patterns. Users often input the sequences of characters, and your system needs to determine whether a query is valid based on specific rules. The valid queries are either: Any combination of '*a*' and '*b*' (including empty strings), or multiple occurrences of the pattern "*ba*". Additionally, the valid query must end with one or more occurrences of a string starting with '*a*', followed by zero or more '*b*'s, and ending with '*a*'. For this scenario construct a DFA through  $\epsilon$ -NFA

10

How can a given DFA be optimized to have the fewest possible states while preserving its language recognition capabilities?

$M = (\{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7\}, \{0,1\}, \delta \text{ (refer table)}, q_0 \text{ (initial state)}, q_2 \text{ (final state)})$

10

| $\delta(\text{state, input})$ | 0     | 1     |
|-------------------------------|-------|-------|
| $\rightarrow q_0$             | $q_1$ | $q_5$ |
| $q_1$                         | $q_6$ | $q_2$ |
| $q_2*$                        | $q_0$ | $q_2$ |
| $q_3$                         | $q_2$ | $q_6$ |
| $q_4$                         | $q_7$ | $q_5$ |
| $q_5$                         | $q_2$ | $q_6$ |
| $q_6$                         | $q_6$ | $q_4$ |
| $q_7$                         | $q_6$ | $q_2$ |

\*\*\*\*\* All the best \*\*\*\*\*



## Continuous Assessment Test(CAT) – I - AUGUST 2024

|                            |   |                                                 |              |   |                 |
|----------------------------|---|-------------------------------------------------|--------------|---|-----------------|
| Programme                  | : | B.Tech. (CSE)                                   | Semester     | : | Fall 2024-25    |
| Course Code & Course Title | : | BECE204L & Microprocessors and Microcontrollers | Class Number | : | CH2024250100392 |
| Faculty                    | : | Dr. Ravi Tiwari                                 | Slot         | : | G2 + TG2        |
| 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.
- Only non-programmable calculator without storage is permitted

**Answer all questions**

| Q. No | Sub Sec. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Marks | Blooms Taxonomy Level |
|-------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------|
| 1.    |          | In what ways do the architectural differences between microcontroller-based and microprocessor-based systems influence their applications in embedded systems, and how might these differences impact design decisions when choosing between the two for a specific project?                                                                                                                                                                                                                                                                                                                              | 5     | L2                    |
| 2.    |          | Design an 8051 assembly language program that implements an 8-bit calculator. The program should execute different arithmetic operations based on the content stored in the memory location 60H (M). Specifically, if M = 0, the program should perform addition; if M = 1, it should perform subtraction; if M = 2, it should perform multiplication; and if M = 3, it should perform division. How would you structure the program to handle these operations and ensure correct execution for each possible value present in the memory location? Use Table 1 for read the input and store the output. | 15    | L3                    |
| 3.    |          | Write an 8051 assembly language program to control the water inflow to a tank using a float sensor as shown in Figure 1. The float sensor is connected to port pin P2.1, the motor controlling the inflow of water is connected to P2.2, and a GREEN LED is connected to P2.3, both of which are normally set to 1. If the sensor detects a high water level                                                                                                                                                                                                                                              | 15    | L4                    |

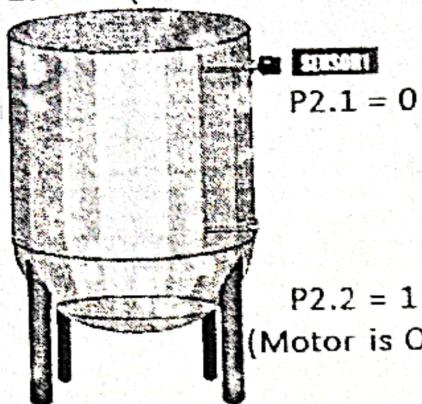
Table 1

| INPUT           |       | OUTPUT                |                 |       |
|-----------------|-------|-----------------------|-----------------|-------|
| Memory Location | Value | Result                | Memory Location | Value |
| D: 40H          | CDH   | Sum                   | D: 50H          | ?     |
| D: 41H          | ABH   | Difference            | D: 51H          | ?     |
|                 |       | Product (lower-byte)  | D: 52H          | ?     |
|                 |       | Product (higher-byte) | D: 53H          | ?     |
|                 |       | Quotient              | D: 54H          | ?     |
|                 |       | Remainder             | D: 55H          | ?     |

CTN  
JNB

(P2.1 = 1), the program should stop the motor by sending a 0 to P2.2 and turn off the GREEN LED. Additionally, the program should light up a RED LED connected to P2.4 to indicate that the tank is full. How would you implement this logic in 8051 assembly language, ensuring proper response to the sensor input?

P2.3 = 1 (Green LED is ON)  
P2.4 = 0 (Red LED is OFF)



P2.3 = 0 (Green LED is OFF)  
P2.4 = 1 (Red LED is ON)

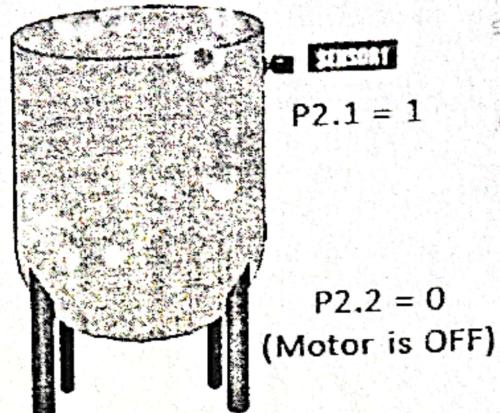


Figure 1

4. (a) Find the time delay of the given 8051 assembly language program. Assume the crystal frequency is 12 MHz. [7 Marks]

| Instruction         | Number of Machine Cycle |
|---------------------|-------------------------|
| MOV R1, #250        | 1                       |
| LABEL: MOV R2, #250 | 1                       |
| HERE: NOP           | 1                       |
| DJNZ R2, HERE       | 2                       |
| DJNZ R1, LABEL      | 2                       |
| RET                 | 2                       |

- (b) Write an 8051 assembly language program to create the delay found in Q.No. 4(a) using Timer 0 in Mode 1. Assume the crystal frequency is 12 MHz. [8 Marks]

\*\*\*\*\* All the best \*\*\*\*\*

15

## Continuous Assessment Test (CAT) – I - AUGUST 2024

|                               |   |                                                                    |              |   |                                                       |
|-------------------------------|---|--------------------------------------------------------------------|--------------|---|-------------------------------------------------------|
| Programme                     | : | B. Tech (CSE)                                                      | Semester     | : | Fall Semester<br>2024-25                              |
| Course Code &<br>Course Title | : | BCSE205L Computer<br>Architecture and Organization                 | Class Number | : | CH2024250101443<br>CH2024250100885<br>CH2024250100532 |
| Faculty                       | : | Dr. M. Asha Jerlin<br>Dr. Kaja Mohideen A<br>Dr. M. Vidhya Lakshmi | Slot         | : | A1+TA1                                                |
| Duration                      | : | 1 ½ hours                                                          | 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.       | Illustrate the stored program concept on a machine that has same memory for storing instructions and data. Explain the operational steps involved with a suitable diagram. [10 marks]<br><br>Load M(X)<br>Mul R3<br>Store M(X)                                                                                                                                               | 15    |
|       | b.       | Considering the address lines in 2 bits and Data lines in 16 bits. Draw and Explain the register file with three access ports for the instruction R4<- R3 - R2. [5 marks]                                                                                                                                                                                                    |       |
| 2     |          | You are buying a new processor. They have two options: a RISC and a CISC processor. Your friend is unsure which one to choose and asks for your advice. He uses the computer for simple tasks like browsing the web, word processing, and light programming. Based on the scenario, which processor would you recommend and justify your recommendation with 5 valid points. | 5     |
| 3     |          | i. Show the step-by-step process for multiplying $(25)_{10}$ and $(-6)_{10}$ . [6 Marks]<br>ii. Validate the correctness of the result. [2 Marks]<br>iii. Find the decimal equivalent of the content of the accumulator at the end of the second iteration. [2 Marks]                                                                                                        | 10    |
| 4     |          | i) Represent the given decimal value $(85.125)_{10}$ into IEEE                                                                                                                                                                                                                                                                                                               | 10    |

|   |  |                                                                                                                                                                                                                                                     |    |
|---|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|   |  | 754 single precision floating number format [4 marks]                                                                                                                                                                                               |    |
|   |  | ii) Add the given decimal numbers $(234.45)_{10}$ and $(122.35)_{10}$ and write the normalized result in IEEE single precision format. [6 Marks]                                                                                                    |    |
| 5 |  | You have been selected as an assembly language programmer at ARC technologies. Your manager has given you an expression:<br>$A = (B * C + D) / (E - R)$ asking you to code it in one, two and three address instructions. Give the program listing. | 10 |

Module-3

- Addressing modes
- Instruction sets (IS) -

Ans B Half C

Ans B \* C

Ans



## Continuous Assessment Test (CAT) – I - AUGUST 2024

|                               |   |                                                                                      |              |   |                                                                          |
|-------------------------------|---|--------------------------------------------------------------------------------------|--------------|---|--------------------------------------------------------------------------|
| Programme                     | : | B.Tech(CSE)                                                                          | Semester     | : | Fall Semester<br>2024-25                                                 |
| Course Code &<br>Course Title | : | BCSE205L Computer<br>Architecture and Organization                                   | Class Number | : | CH2024250100533<br>CH2024250101444<br>CH2024250102663<br>CH2024250100888 |
| Faculty                       | : | Dr.A.R.Revathi<br>Dr.R.M.Bhavadharani<br>Dr.R.Madura Meenakshi<br>Dr.A.Kaja Mohideen | Slot         | : | A2+TA2                                                                   |
| Duration                      | : | 1 ½ hours                                                                            | 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>Suppose you are an architect at Zion Computers and you are assigned the task of designing a processor that stores both data and instructions in the same memory and always accesses a pair of instructions at a time. You are provided with the following set of instructions</p> <p><b>LOAD LOCA, R1</b><br/> <b>SUB R1, R2</b><br/> <b>STORE R1, LOCB</b></p> <p>Where LOCA, LOCB are two different memory addresses and R1, R2 are registers. Assume the register R2 contains value 50.</p> <p>Identify the suitable architecture for the given scenario and explain its structure with a neat diagram. [5 marks]</p> | 10<br><i>Cooling</i> |
|       | b.       | For the above instructions, explain the sequence of operations performed by the CPU as it executes each instruction. What will be the final content of memory location LOCB after the program has executed? [5 marks]                                                                                                                                                                                                                                                                                                                                                                                                       |                      |
| 2     |          | <p>A processor supports the following instructions:</p> <p><b>MOV R0, [SI]</b> – Load the value from the memory address pointed to by the Source Index (SI) into register R0.</p> <p><b>MOV [DI], R1</b> – Store the value from register R1 into the memory address pointed to by the Destination Index (DI).</p> <p><b>PUSH R2</b> – Push the value in register R2 onto the stack.</p>                                                                                                                                                                                                                                     |                      |

|   |                                                                                                                                                                                                                                                                                                                                                                |    |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|   | <p><b>POP R3</b> – Pop the top value from the stack into register R3.</p> <p><b>MOV BP, SP</b> – Copy the current stack pointer into the base pointer.</p> <p>What are the different categories of registers used for executing the above set of instructions? Explain each of their specific roles towards the execution of the above instructions.</p>       | 10 |
| 3 | <p>a) Design an algorithm for division of unsigned numbers using restoring approach. [4 Marks]</p> <p>b) Show the working of your algorithm for <math>(19)_{10} \div (5)_{10}</math> with all intermediate steps.[6 Marks]</p>                                                                                                                                 | 10 |
| 4 | <p>Perform the following Floating-point operation on the numbers <math>(251.75)_{10}</math> and <math>(142.525)_{10}</math>.</p> <p>a) Convert the above decimal numbers to normalized notation of binary format. [4 Marks]</p> <p>b) Perform subtraction for the given numbers and write the normalized result in IEEE single precision format. [6 Marks]</p> | 10 |
| 5 | <p>Identify the addressing mode used in each of the instructions below and explain how the effective address is calculated for each one.</p> <p>(i) MOV R1, #10<br/> (ii) ADD R4, R1, 10[R3]      <math>R1 + [R3] \times 10</math><br/> (iii) DIV R3, (R2)<br/> (iv) SUB R1, [PC+4]<br/> (v) MUL R1, (R2)+</p>                                                 | 10 |



**VIT**

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CHENNAI

## Continuous Assessment Test I - August 2024

|                                                                                                                                                                                                                              |                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Programme : B.Tech.                                                                                                                                                                                                          | Semester : FALL 2024-25                                                                        |
| Course : Discrete Mathematics and Graph Theory                                                                                                                                                                               | Code : BMAT205L                                                                                |
| Faculty : Dr. Kalyan Manna, Dr. Nathiya,<br>Dr. Vidhya, Prof. Sumathi,<br>Dr. Om Namha Shivay Dr. Pavithra,<br>Prof. Sakthi Devi, Dr. Ashish Kumar<br>Nandhi, Dr. Dhivya P, Dr. Berin Greeni,<br>Dr. Radha, Dr. Sandip Saha. | Slot : D2+TD2+TDD2                                                                             |
| Time : 90 Minutes                                                                                                                                                                                                            | Class ID : CH2024250102089, 2090,<br>2093, 2095, 2096<br>2098, 2101, 2102, 2191,<br>2195, 2197 |
|                                                                                                                                                                                                                              | Max.Marks : 50                                                                                 |

Answer all the Questions ( $5 \times 10 = 50$ )

- A. (a) Determine whether the following argument is valid or not: The meeting can take place if all members are informed in advance and there is quorum (a minimum number of members are present). There is a quorum if at least 20 members are present. Members would have been informed in advance if there was no strike. Therefore, if the meeting was cancelled, then either there were fewer than 20 members present or there was a strike. [6]
- (b) Let  $p$  and  $q$  be two propositions stating "Land slide happened" and "Disaster team rescued people" respectively. Write the statements corresponding to the following propositions: [4]
- i)  $\neg p \wedge q$
  - ii)  $p \leftrightarrow q$
  - iii)  $\neg q \rightarrow \neg p$
  - iv)  $p \vee \neg q$
- B. (a) Write the inverse, converse and contrapositive statements of "He scored high unless he studied well." [4]
- (b) Find the PDNF and PCNF of  $(\neg p \vee \neg q) \rightarrow (p \leftrightarrow \neg q)$ . [6]
3. (a) Let  $G = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 & 1 \end{bmatrix}$  be the generator matrix. Find all code words. [8]  
Also find the corresponding parity check matrix to decode the following received words: 101011, 110010, 101110, 100111, 001110 and 110101.
- (b) Is it possible to find a subgroup of order 3 for the group  $(Z_{13}, +_{13})$ ? If so, write the subgroup otherwise give reasons. [2]
4. (a) Show that  $(Z_2 \times Z_2, +_2)$  is an abelian group with respect to addition module 2. [5]

- \* VIT-CHENNAI \* VIT-CHENNAI \* VIT-CHENNAI \*
- (b) Consider the direct product  $\mathbb{R} \times \mathbb{R}$  of the additive group of real numbers. Check whether the subset  $H = \{(x, y) \in \mathbb{R} \times \mathbb{R}, \text{ such that } 2x + y = 0\}$  is a subgroup of  $\mathbb{R} \times \mathbb{R}$  or not. [3]
- (c) Check whether  $T : (\mathbb{R}, +) \rightarrow (\mathbb{R}, +)$  defined by  $T(x) = \underline{2x^2 + 1}$  is a group homomorphism or not. [2]
- Q. (a) Write symbolic representation and the negation of the following: [5]
- i) Every integer which is divisible by 10 is also divisible by 2.
  - ii) Some integers which are divisible by 2 are also divisible by 5.
- (b) Prove  $(\forall x)[p(x) \rightarrow q(x)], (\forall x)[r(x) \rightarrow \neg q(x)]$  implies  $\forall x[r(x) \rightarrow \neg p(x)]$



## Continuous Assessment Test (CAT) – I - AUG 2024

|                            |   |                                                                                                                                                                                                                    |              |   |                                                                                                                                                                                            |
|----------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Programme                  | : | B. Tech (CSE and its specialisation)                                                                                                                                                                               | Semester     | : | Fall 24-25                                                                                                                                                                                 |
| Course Code & Course Title | : | BCSE308L – Computer Networks                                                                                                                                                                                       | Class Number | : | CH2024250100847<br>CH2024250100849<br>CH2024250100856<br>CH2024250100932<br>CH2024250100936<br>CH2024250100938<br>CH2024250100539<br>CH2024250101460<br>CH2024250101463<br>CH2024250100861 |
| Faculty                    | : | Prof. NEELANARAYANAN V<br>Prof. PUNITHA K<br>Prof. KARMELA<br>Prof. SHYAMALA L<br>Prof. MENAKA PUSHPA A<br>Prof. SWAMINATHAN A<br>Prof. SUDHAA<br>Prof. DHANALAKSHMI R<br>Prof. DEEPA NIVETHIKA<br>Prof. KABILAN K | Slot         | : | F2+TF2                                                                                                                                                                                     |
| Duration                   | : | 1½ Hours                                                                                                                                                                                                           | Max. Mark    | : | 50                                                                                                                                                                                         |

**General Instructions:**

- Write only your registration number on the question paper in the box provided and do not write other information.
- Only non-programmable calculator without storage is permitted

**Answer all questions**

| Q. No | Sub Sec. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Marks |
|-------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1.    |          | <p>A company has 10 computers that need to be connected using any one of the network topologies, except hybrid topology. The company is considering the following metrics: (i) cost of cabling, and (ii) network reliability. The cost of cabling per meter is Rs.50 and the cost of RJ45 Connector is Rs.5 per piece. The average distance between any two computers is 10 meters.</p> <p>Based on the above scenario answer the following questions by considering the different possible network topologies:</p> <p>a) Calculate the total number of cables required in each topology. [5 Marks]<br/> b) Calculate the total number of RJ45 Connectors required in each topology. [4 Marks]<br/> c) Based on the above calculations, which topology should the company choose if their primary concern is (i) cost, (ii) reliability, and (iii) network performance? Justify your</p> | 15    |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |    |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
|    | answer. [6 Marks]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |    |
| 2. | Assume that translation, encryption and compression are some of responsibilities of the layer in the OSI model. According to you, explain which layer is responsible for these responsibilities in TCP/IP model? Explain your answer precisely.                                                                                                                                                                                                                                                                                                                                                                                                  | 5  |
| 3. | A professor performed a wireless site survey at VIT Chennai campus auditorium hall to determine the number of access points required and their proper placements so that the professor would have the necessary radio frequency coverage. After ten days, the professor delivered a lecture with massive crowd in the same auditorium. During this lecture, the signal strength and quality of the wireless area network were not desirable.<br><br>i. In your opinion, find out the reasons for the deficient performance. [3 Marks]<br>ii. List and explain all the performance parameters caused this deficiency in communication. [ 7 Marks] | 10 |
| 4. | Assume that host A wants to send 4 frames (of 10 bytes each). The timeout values at hosts A and B are $2 * \text{RTT}$ . Suppose that the 2 <sup>nd</sup> frame is lost whereas all the following frames and all acknowledgments are delivered without error. The hosts can use Go-Back-N (GBN) and Selective Repeat (SR).<br><br>i. Draw the complete data transmission sequences for the above scenario using both the techniques. [8 Marks]<br>ii. As an expert, suggest better mechanism for a greater number of data transmission. Justify your choice. [2 Marks]                                                                           | 10 |
| 5. | i. Explain how the CRC-32 algorithm generates a CRC code for a given data frame. Provide a step-by-step description of the process, including how the generator polynomial is used. Then, describe how the receiver uses the CRC to detect errors in received data. [3 Marks]<br><br>ii. If the data frame is 1101011011 and the generator polynomial is 10011, calculate the CRC code for this data frame and demonstrate the process involved in both the sender and receiver side.[7 Marks]                                                                                                                                                   | 10 |

\*\*\*\*\*All the best\*\*\*\*\*



Physical  
Data Link  
Network  
Transport  
Presentation  
Application



Continuous Assessment Test (CAT-I) – AUG 2024

|                |                                                                                                                                                                                                                                                                                                                                                                     |                |                                                                                                                                                                                                                                                                                                                                 |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Programme :    | B. Tech CSE and its specializations                                                                                                                                                                                                                                                                                                                                 | Semester :     | Fall 2024– 2025                                                                                                                                                                                                                                                                                                                 |
| Course Title : | Data structures and Algorithms                                                                                                                                                                                                                                                                                                                                      | Code :         | BCSE202L                                                                                                                                                                                                                                                                                                                        |
| Faculty :      | Dr. VIJAYALAKSHMI A<br>Dr. AMRIT PAL<br>Dr. RISHIKESHAN C A<br>Dr. KALAIPRIYAN<br>Dr. RAJAKUMAR<br>Dr. VALARMATHI SUDHAKAR<br>Dr. ABISHI CHOWDHURY<br>Dr. SENTHIL KUMAR A M<br>Dr. VINOETHINI A<br>Dr. DOMINIC SAVIO M<br>Dr. SENDHIL R<br>Dr. ILAVENDHAN A<br>Dr. SUDHEER KUMAR E<br>Dr. BALASARASWATHI<br>Dr. BALRAJ E<br>Dr. HELEN VIJITHA P<br>Dr. MANIKANDAN P | Slot :         | E2+TE2                                                                                                                                                                                                                                                                                                                          |
|                |                                                                                                                                                                                                                                                                                                                                                                     | Class Number : | CH2024250100821<br>CH2024250100989<br>CH2024250101061<br>CH2024250100527<br>CH2024250100529<br>CH2024250100999<br>CH2024250100993<br>CH2024250101434<br>CH2024250100850<br>CH2024250100794<br>CH2024250100803<br>CH2024250100820<br>CH2024250101436<br>CH2024250101435<br>CH2024250101000<br>CH2024250100864<br>CH2024250100996 |
| Time :         | 90 Minutes                                                                                                                                                                                                                                                                                                                                                          | Max. Marks :   | 50                                                                                                                                                                                                                                                                                                                              |

**General Instructions:**

- Write only your registration number on the question paper in the box provided and do not write any other information.
- If additional information is required for answering any question, assume the same and mention it in the answer.

**Answer all questions**

| Sub<br>Q.No.<br>Sec. | Question Description                                                                                                                                                           | Marks                          |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| 1.                   | Solve the following recurrence relations and compute their time complexities.<br><br>a. $T(n) = T(n-1) + n^4$ , $T(0) = 0$ b. $T(n) = 2T(n/4) + \sqrt{n}$ , $T(1) = 1$         | [5 Marks]      10<br>[5 Marks] |
| 2.                   | Find the worst-case running time of the following algorithm and justify your answer.<br><br>Algorithm ABC(A, n)<br>sum = 0<br>for i = 1 to n do<br>{<br>for j = 1 to n do<br>{ | 10                             |

```

for k = 1 to j do
{
    m = k
    while m < n do
    {
        sum = sum + A[m]
        m = 2 * m
    }
}

for p = 1 to n do
{
    q = 1
    {
        while q < p do
        {
            sum = sum + A[q]
            q = q + 1
        }
    }
}
for r = 1 to n do
{
    for s = r to n do
    {
        sum = sum + A[s] * A[r]
    }
}
return sum

```

3. Assume  $A1[] = \{6, 2, 1, 8, 7\}$  and  $A2[] = \{1, 2, 6, 7, 8\}$  are two different arrays.  $A1$  is in unsorted order and  $A2$  is in sorted order. Let  $k$  be the number. Write two different algorithms to check a given number  $k$  is present or not in  $A1$  and  $A2$ . Analyze the time complexities of the two different algorithms. 10
4. Consider the modern Cartesian coordinate system is represented by a pair of coordinates  $(x, y)$  in two dimensions, where the two axes are the horizontal  $(x)$  axis and vertical  $(y)$  axis 10

Given  $n$  distinct points with  $(x, y)$  coordinates, the task is to devise an algorithm to sort these points. The assumption is that each point has unique coordinates, meaning that no two points share the same  $(x, y)$  values.

To sort the coordinates follow the below conditions:

Sort the  $(x, y)$  coordinates in ascending order based on their  $x$ -values. If  $x$ -coordinate is same, sort the coordinates based on its  $y$ -coordinate.

Consider the following points:

(7, -7), (-1, 3), (0, 0), (-1, 2), (4, 5), (5, -4), (6, 2), (4, -9), (-2, -7)

After sorting:

(-2, -7), (-1, 2), (-1, 3), (0, 0), (4, -9), (4, 5), (5, -4), (6, 2), (7, -7)

5. Suppose that you are part of a team developing a financial application. One of the functions used in the application is a calculator. Apply appropriate algorithms to compute the given arithmetic expression using suitable data structure. Illustrate the step by step process of your algorithm with the given example and find the result. 10

Example:

Input:  $5 * (((9 + 8) * (4 * 6)) + 7)$

$\underline{(9 + 8)} * (4 * 6) + 7$

$$\begin{array}{r} 9 \\ + 8 \\ \hline 17 \\ \times 4 \\ \hline 68 \\ + 2 \\ \hline 240 \\ + 5 \\ \hline 245 \\ + 7 \\ \hline 252 \end{array}$$