



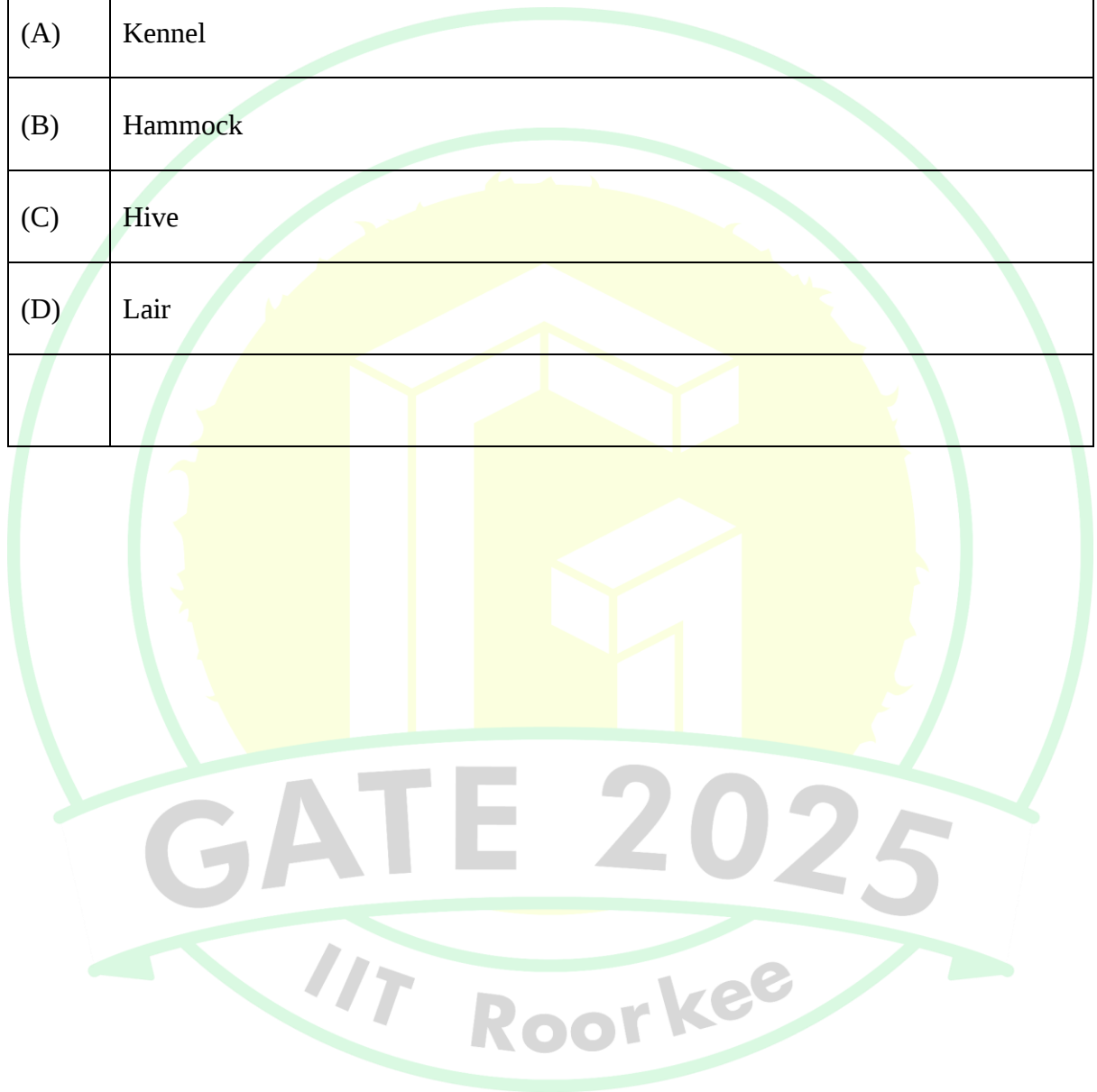
**General Aptitude**

**Q.1 – Q.5 Carry ONE mark Each**

|     |                                                                                                                                                                                     |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.1 | Despite his initial hesitation, Rehman's _____ to contribute to the success of the project never wavered.<br><br>Select the most appropriate option to complete the above sentence. |
|     |                                                                                                                                                                                     |
| (A) | ambivalence                                                                                                                                                                         |
| (B) | satisfaction                                                                                                                                                                        |
| (C) | resolve                                                                                                                                                                             |
| (D) | revolve                                                                                                                                                                             |
|     |                                                                                                                                                                                     |

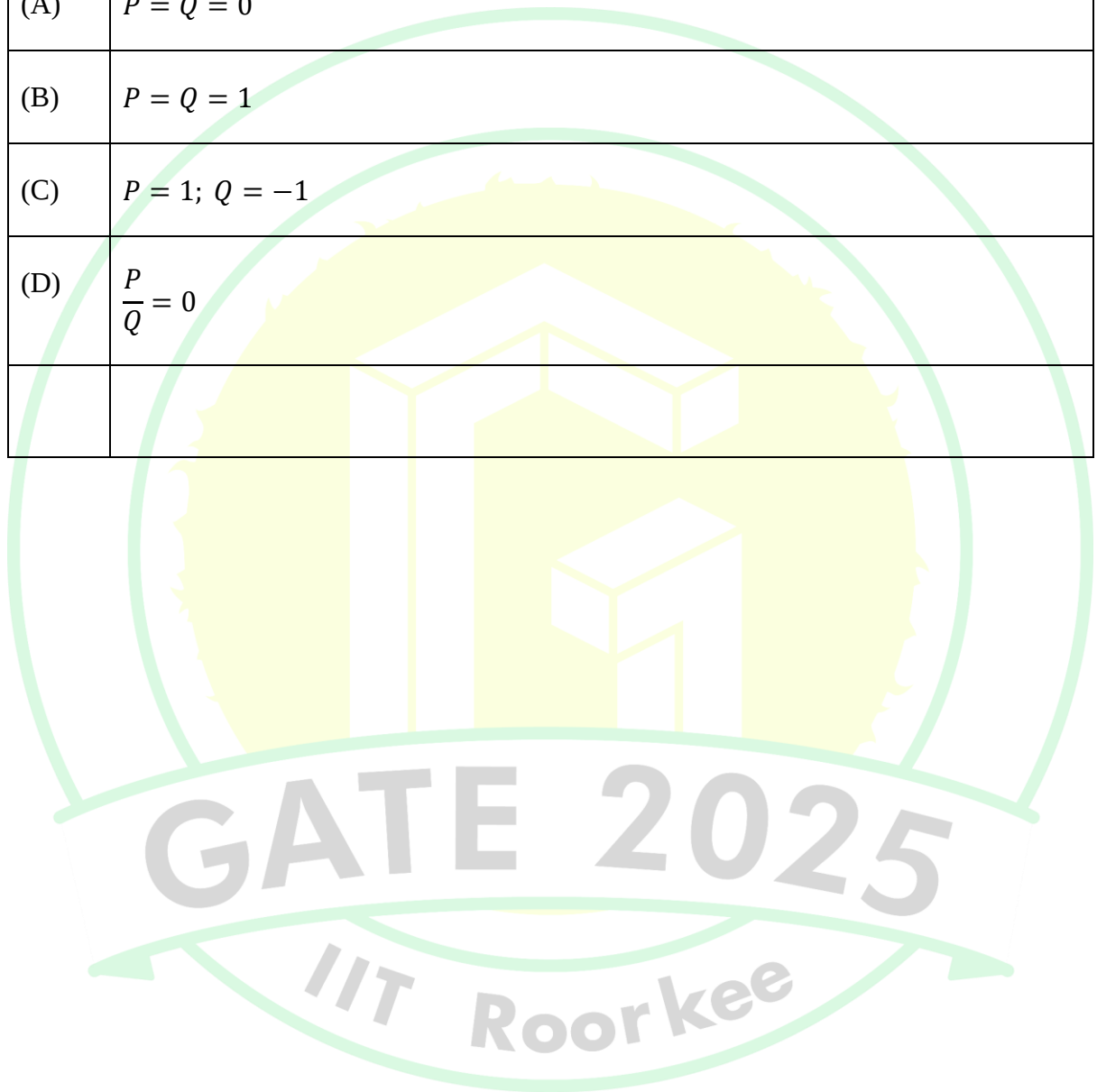


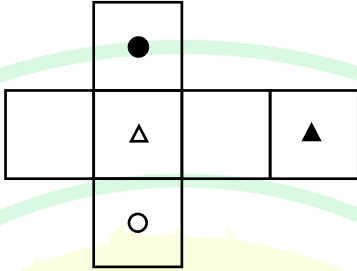
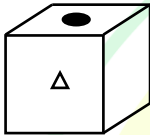
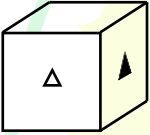
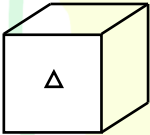
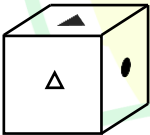
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| Q.2 | Bird : Nest :: Bee : _____<br>Select the correct option to complete the analogy. |
|     |                                                                                  |
| (A) | Kennel                                                                           |
| (B) | Hammock                                                                          |
| (C) | Hive                                                                             |
| (D) | Lair                                                                             |
|     |                                                                                  |





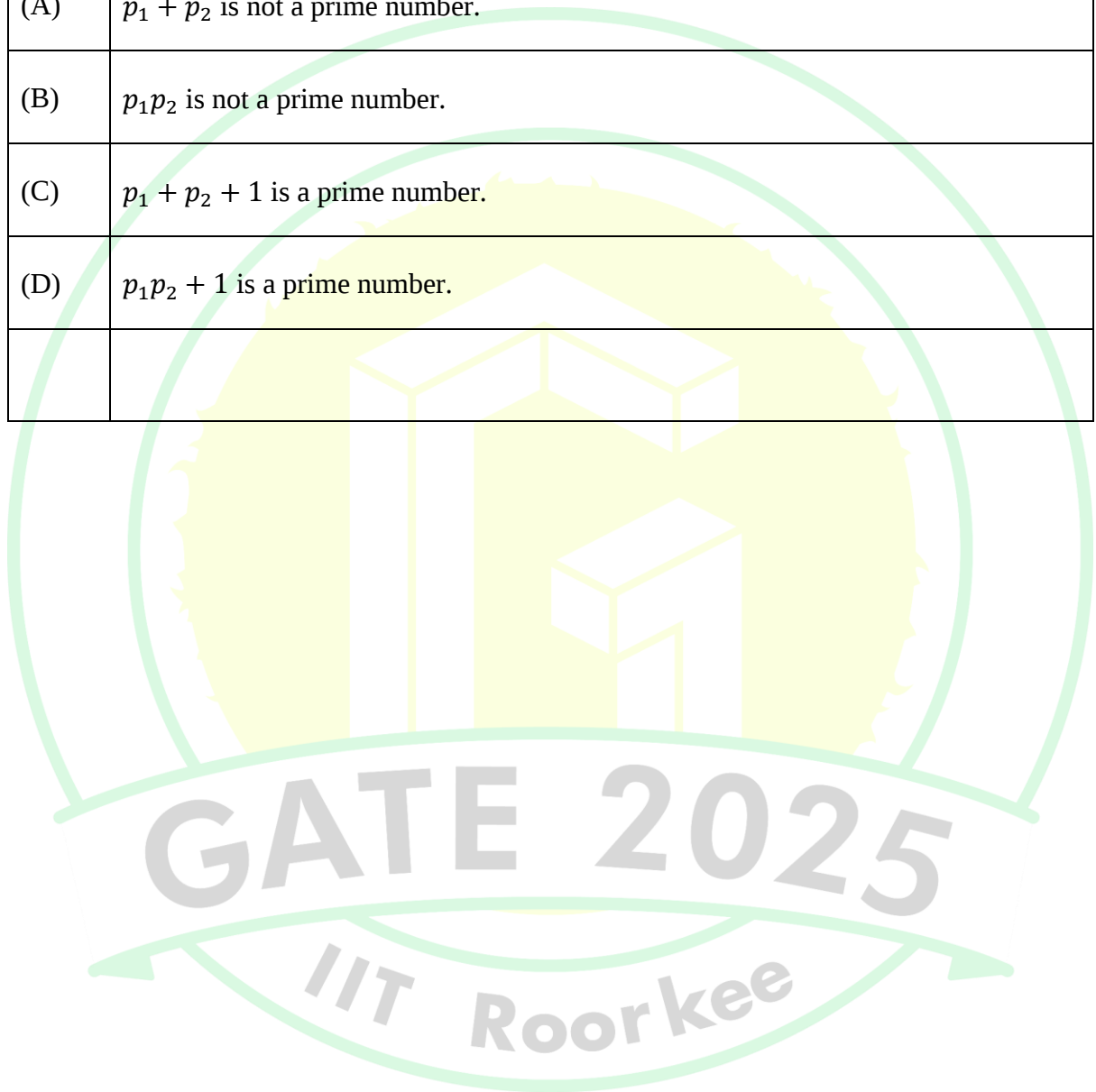
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| Q.3 | If $Pe^x = Qe^{-x}$ for all real values of $x$ , which one of the following statements is true? |
|     |                                                                                                 |
| (A) | $P = Q = 0$                                                                                     |
| (B) | $P = Q = 1$                                                                                     |
| (C) | $P = 1; Q = -1$                                                                                 |
| (D) | $\frac{P}{Q} = 0$                                                                               |
|     |                                                                                                 |



|     |                                                                                                                                                                                                                                                       |
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| Q.4 | <p>The paper as shown in the figure is folded to make a cube where each square corresponds to a particular face of the cube. Which one of the following options correctly represents the cube?</p> <p>Note: The figures shown are representative.</p> |
|     |                                                                                                                                                                      |
| (A) |                                                                                                                                                                      |
| (B) |                                                                                                                                                                     |
| (C) |                                                                                                                                                                    |
| (D) |                                                                                                                                                                    |



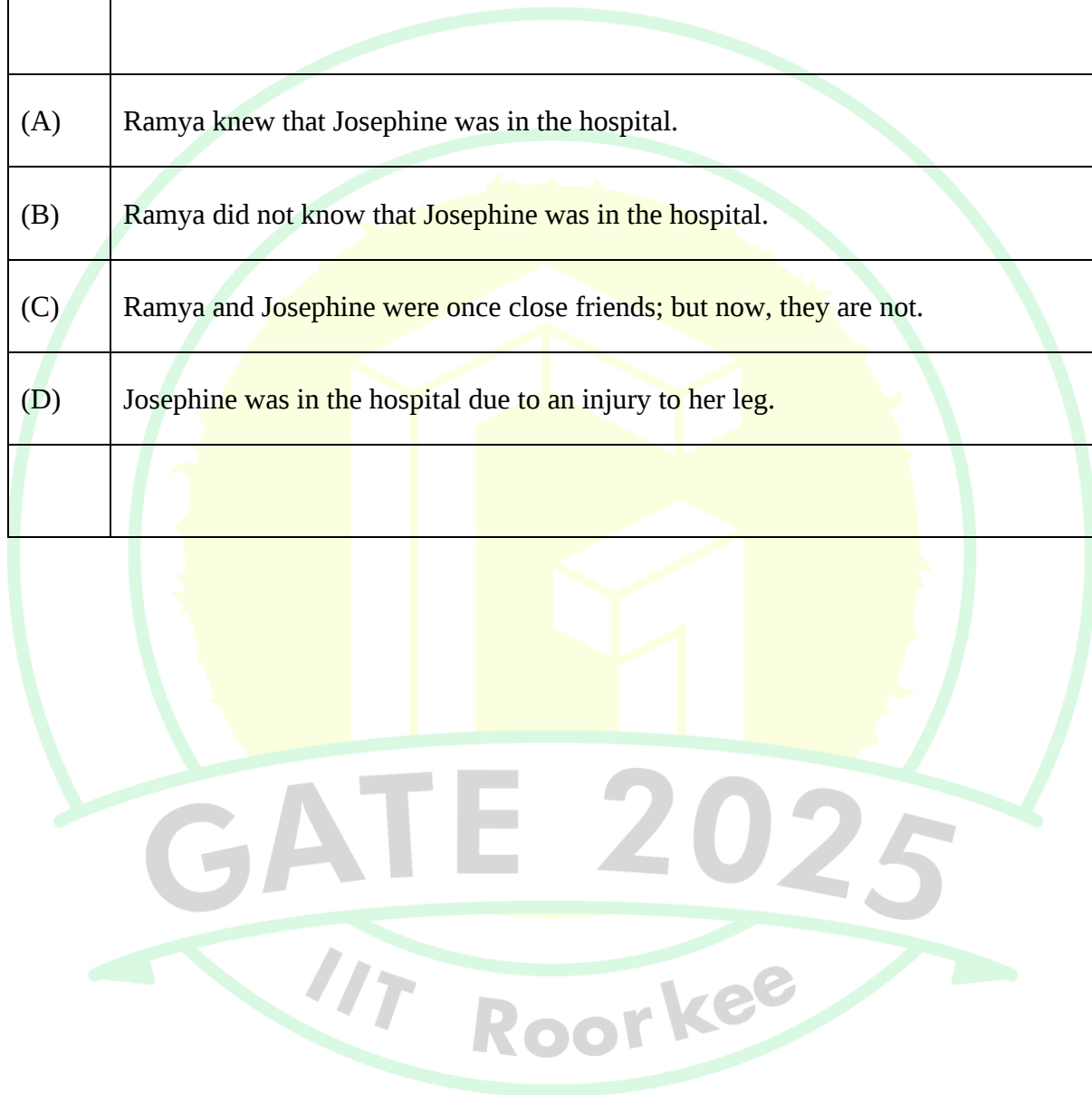
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| Q.5 | Let $p_1$ and $p_2$ denote two arbitrary prime numbers. Which one of the following statements is correct for all values of $p_1$ and $p_2$ ? |
|     |                                                                                                                                              |
| (A) | $p_1 + p_2$ is not a prime number.                                                                                                           |
| (B) | $p_1 p_2$ is not a prime number.                                                                                                             |
| (C) | $p_1 + p_2 + 1$ is a prime number.                                                                                                           |
| (D) | $p_1 p_2 + 1$ is a prime number.                                                                                                             |
|     |                                                                                                                                              |





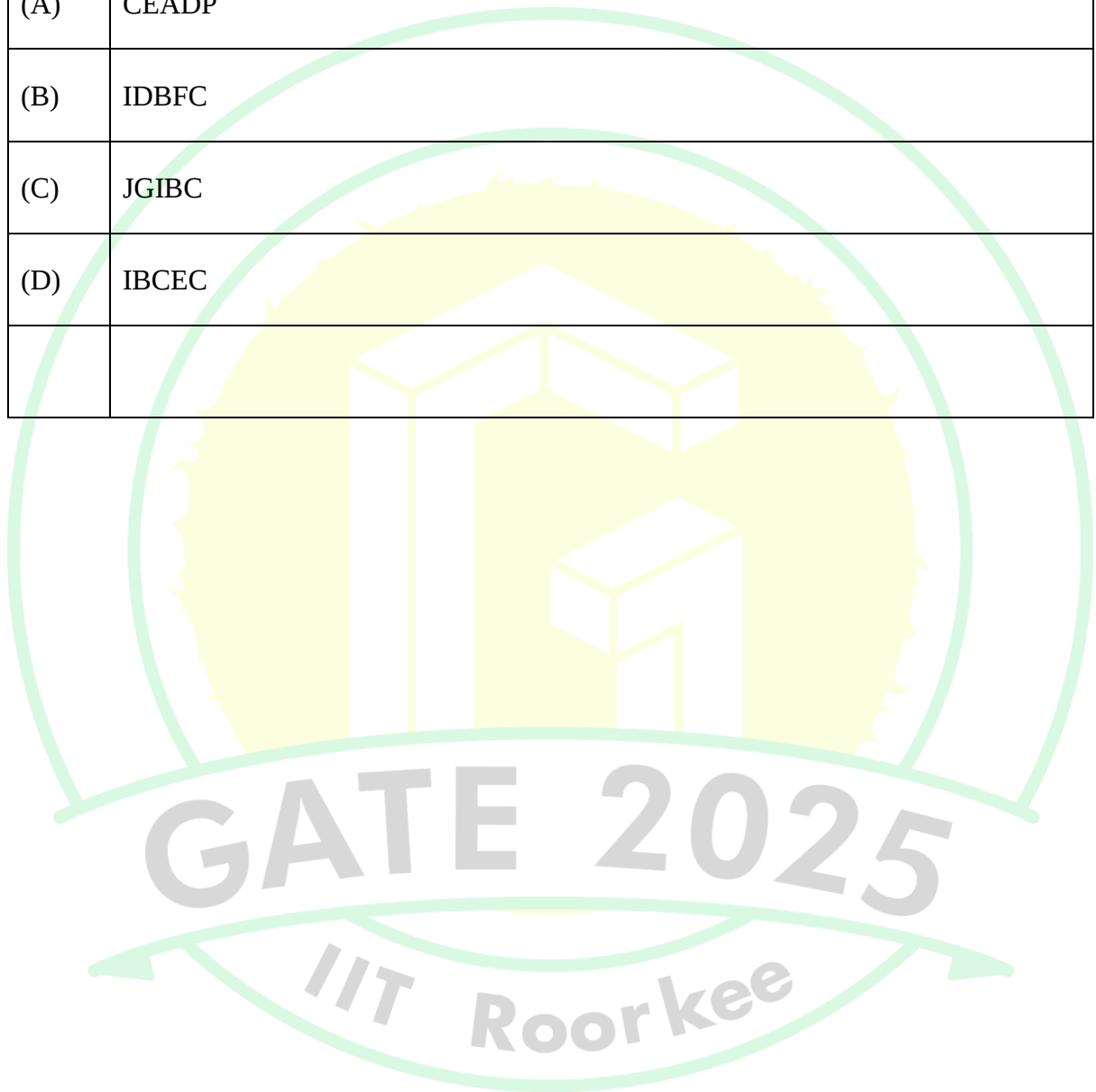
**Q.6 – Q.10 Carry TWO marks Each**

|     |                                                                                                                                                                                                           |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.6 | Based only on the conversation below, identify the logically correct inference:<br><br>“Even if I had known that you were in the hospital, I would not have gone there to see you”, Ramya told Josephine. |
|     |                                                                                                                                                                                                           |
| (A) | Ramya knew that Josephine was in the hospital.                                                                                                                                                            |
| (B) | Ramya did not know that Josephine was in the hospital.                                                                                                                                                    |
| (C) | Ramya and Josephine were once close friends; but now, they are not.                                                                                                                                       |
| (D) | Josephine was in the hospital due to an injury to her leg.                                                                                                                                                |
|     |                                                                                                                                                                                                           |

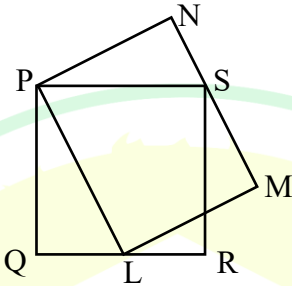


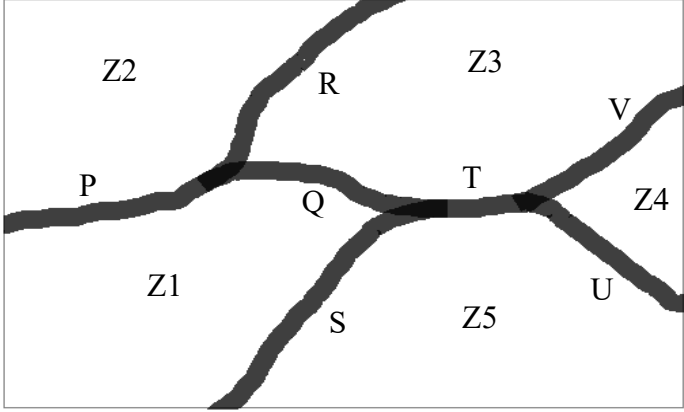


|     |                                                                                                                                               |
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| Q.7 | If IMAGE and FIELD are coded as FHBNJ and EMFJG respectively then, which one among the given options is the most appropriate code for BEACH ? |
|     |                                                                                                                                               |
| (A) | CEADP                                                                                                                                         |
| (B) | IDBFC                                                                                                                                         |
| (C) | JGIBC                                                                                                                                         |
| (D) | IBCEC                                                                                                                                         |
|     |                                                                                                                                               |



|                   |                                                                                                                                                                                                                                                                                                                                                                          |                   |      |        |   |   |               |    |    |    |    |                |    |    |    |    |                |    |     |      |        |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|------|--------|---|---|---------------|----|----|----|----|----------------|----|----|----|----|----------------|----|-----|------|--------|
| Q.8               | Which one of the following options is correct for the given data in the table?                                                                                                                                                                                                                                                                                           |                   |      |        |   |   |               |    |    |    |    |                |    |    |    |    |                |    |     |      |        |
|                   | <table><tr><td>Iteration (<math>i</math>)</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>Input (<math>I</math>)</td><td>20</td><td>-4</td><td>10</td><td>15</td></tr><tr><td>Output (<math>X</math>)</td><td>20</td><td>16</td><td>26</td><td>41</td></tr><tr><td>Output (<math>Y</math>)</td><td>20</td><td>-80</td><td>-800</td><td>-12000</td></tr></table> | Iteration ( $i$ ) | 0    | 1      | 2 | 3 | Input ( $I$ ) | 20 | -4 | 10 | 15 | Output ( $X$ ) | 20 | 16 | 26 | 41 | Output ( $Y$ ) | 20 | -80 | -800 | -12000 |
| Iteration ( $i$ ) | 0                                                                                                                                                                                                                                                                                                                                                                        | 1                 | 2    | 3      |   |   |               |    |    |    |    |                |    |    |    |    |                |    |     |      |        |
| Input ( $I$ )     | 20                                                                                                                                                                                                                                                                                                                                                                       | -4                | 10   | 15     |   |   |               |    |    |    |    |                |    |    |    |    |                |    |     |      |        |
| Output ( $X$ )    | 20                                                                                                                                                                                                                                                                                                                                                                       | 16                | 26   | 41     |   |   |               |    |    |    |    |                |    |    |    |    |                |    |     |      |        |
| Output ( $Y$ )    | 20                                                                                                                                                                                                                                                                                                                                                                       | -80               | -800 | -12000 |   |   |               |    |    |    |    |                |    |    |    |    |                |    |     |      |        |
| (A)               | $X(i) = X(i - 1) + I(i); \quad Y(i) = Y(i - 1)I(i); \quad i > 0$                                                                                                                                                                                                                                                                                                         |                   |      |        |   |   |               |    |    |    |    |                |    |    |    |    |                |    |     |      |        |
| (B)               | $X(i) = X(i - 1)I(i); \quad Y(i) = Y(i - 1) + I(i); \quad i > 0$                                                                                                                                                                                                                                                                                                         |                   |      |        |   |   |               |    |    |    |    |                |    |    |    |    |                |    |     |      |        |
| (C)               | $X(i) = X(i - 1)I(i); \quad Y(i) = Y(i - 1)I(i); \quad i > 0$                                                                                                                                                                                                                                                                                                            |                   |      |        |   |   |               |    |    |    |    |                |    |    |    |    |                |    |     |      |        |
| (D)               | $X(i) = X(i - 1) + I(i); \quad Y(i) = Y(i - 1)I(i - 1); \quad i > 0$                                                                                                                                                                                                                                                                                                     |                   |      |        |   |   |               |    |    |    |    |                |    |    |    |    |                |    |     |      |        |
|                   |                                                                                                                                                                                                                                                                                                                                                                          |                   |      |        |   |   |               |    |    |    |    |                |    |    |    |    |                |    |     |      |        |

|     |                                                                                                                                                                                                                                                                                                                                       |
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| Q.9 | <p>In the given figure, PQRS is a square of side 2 cm and PLMN is a rectangle. The corner L of the rectangle is on the side QR. Side MN of the rectangle passes through the corner S of the square.</p> <p>What is the area (in <math>\text{cm}^2</math>) of the rectangle PLMN?</p> <p>Note: The figure shown is representative.</p> |
|     |                                                                                                                                                                                                                                                      |
| (A) | $2\sqrt{2}$                                                                                                                                                                                                                                                                                                                           |
| (B) | 2                                                                                                                                                                                                                                                                                                                                     |
| (C) | 8                                                                                                                                                                                                                                                                                                                                     |
| (D) | 4                                                                                                                                                                                                                                                                                                                                     |

|      |                                                                                                                                                                                                                                                                                                                                                |
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| Q.10 | <p>The diagram below shows a river system consisting of 7 segments, marked P, Q, R, S, T, U, and V. It splits the land into 5 zones, marked Z1, Z2, Z3, Z4, and Z5. We need to connect these zones using the least number of bridges. Out of the following options, which one is correct?</p> <p>Note: The figure shown is representative.</p> |
|      |                                                                                                                                                                                                                                                              |
| (A)  | Bridges on P, Q, and T                                                                                                                                                                                                                                                                                                                         |
| (B)  | Bridges on P, Q, S, and T                                                                                                                                                                                                                                                                                                                      |
| (C)  | Bridges on Q, R, T, and V                                                                                                                                                                                                                                                                                                                      |
| (D)  | Bridges on P, Q, S, U, and V                                                                                                                                                                                                                                                                                                                   |
|      |                                                                                                                                                                                                                                                                                                                                                |

**Q.11 – Q.35 Carry ONE mark Each**

|      |                                                                                                        |
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| Q.11 | If $A = \begin{pmatrix} 1 & 2 \\ 2 & -1 \end{pmatrix}$ , then which ONE of the following is $A^8$ ?    |
| (A)  | $\begin{pmatrix} 25 & 0 \\ 0 & 25 \end{pmatrix}$                                                       |
| (B)  | $\begin{pmatrix} 125 & 0 \\ 0 & 125 \end{pmatrix}$                                                     |
| (C)  | $\begin{pmatrix} 625 & 0 \\ 0 & 625 \end{pmatrix}$                                                     |
| (D)  | $\begin{pmatrix} 3125 & 0 \\ 0 & 3125 \end{pmatrix}$                                                   |
| Q.12 | The value of $x$ such that $x > 1$ , satisfying the equation $\int_1^x t \ln t \, dt = \frac{1}{4}$ is |
| (A)  | $\sqrt{e}$                                                                                             |
| (B)  | $e$                                                                                                    |
| (C)  | $e^2$                                                                                                  |
| (D)  | $e - 1$                                                                                                |

|      |                                                                                                                                                                                                                                                                                  |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.13 | <p>Consider a binary tree <math>T</math> in which every node has either zero or two children. Let <math>n &gt; 0</math> be the number of nodes in <math>T</math>.</p> <p>Which ONE of the following is the number of nodes in <math>T</math> that have exactly two children?</p> |
| (A)  | $\frac{n-2}{2}$                                                                                                                                                                                                                                                                  |
| (B)  | $\frac{n-1}{2}$                                                                                                                                                                                                                                                                  |
| (C)  | $\frac{n}{2}$                                                                                                                                                                                                                                                                    |
| (D)  | $\frac{n+1}{2}$                                                                                                                                                                                                                                                                  |
|      |                                                                                                                                                                                                                                                                                  |

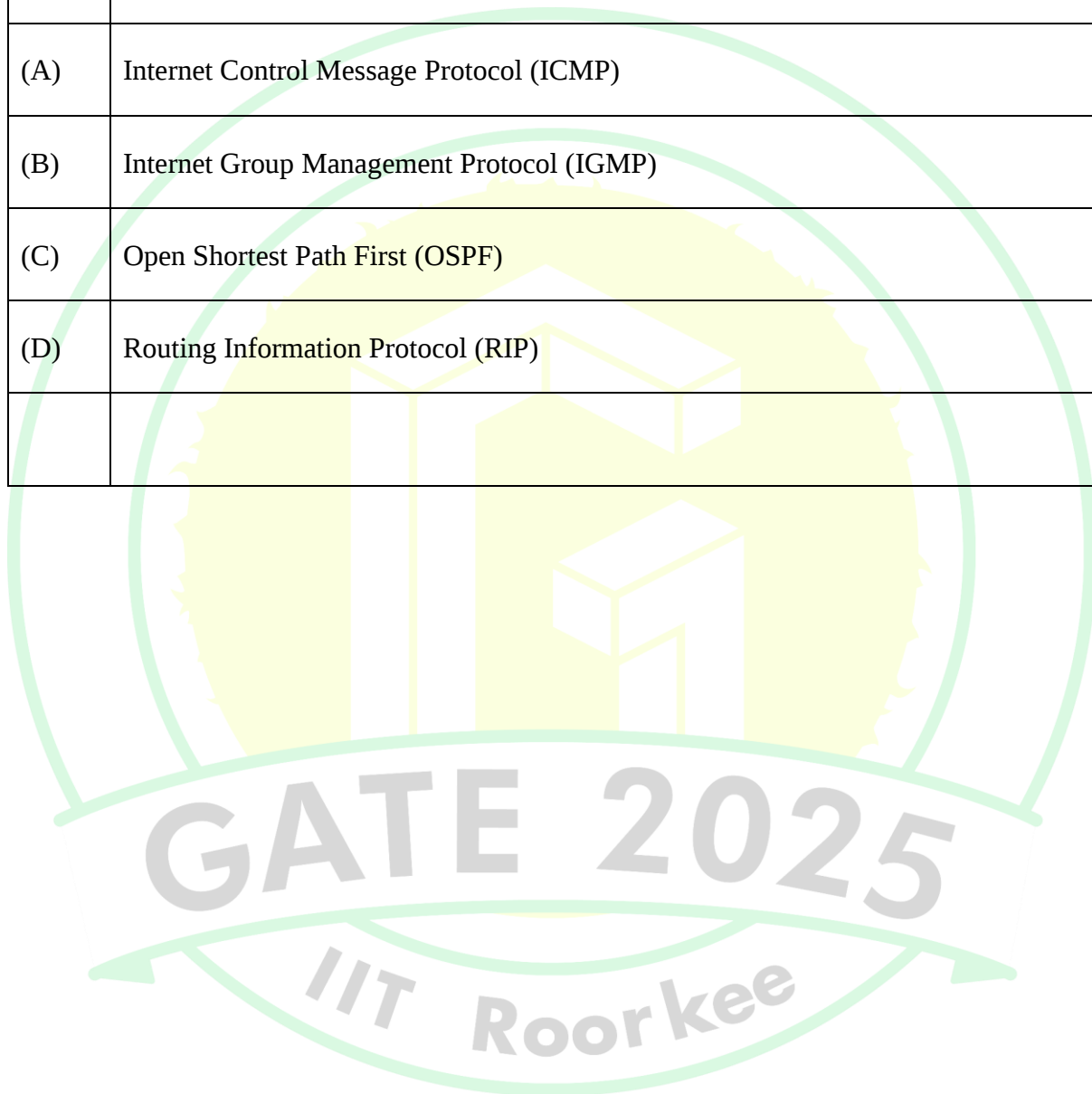
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| Q.14 | <p>Let <math>L, M</math>, and <math>N</math> be non-singular matrices of order 3 satisfying the equations <math>L^2 = L^{-1}</math>, <math>M = L^8</math> and <math>N = L^2</math>.</p> <p>Which ONE of the following is the value of the determinant of <math>(M - N)</math>?</p> |
| (A)  | 0                                                                                                                                                                                                                                                                                  |
| (B)  | 1                                                                                                                                                                                                                                                                                  |
| (C)  | 2                                                                                                                                                                                                                                                                                  |
| (D)  | 3                                                                                                                                                                                                                                                                                  |
| Q.15 | <p>Let <math>P(x)</math> be an arbitrary predicate over the domain of natural numbers.</p> <p>Which ONE of the following statements is TRUE?</p>                                                                                                                                   |
| (A)  | $(P(0) \wedge (\forall x [P(x) \Rightarrow P(x + 1)])) \Rightarrow (\forall x P(x))$                                                                                                                                                                                               |
| (B)  | $(P(0) \wedge (\forall x [P(x) \Rightarrow P(x - 1)])) \Rightarrow (\forall x P(x))$                                                                                                                                                                                               |
| (C)  | $(P(1000) \wedge (\forall x [P(x) \Rightarrow P(x - 1)])) \Rightarrow (\forall x P(x))$                                                                                                                                                                                            |
| (D)  | $(P(1000) \wedge (\forall x [P(x) \Rightarrow P(x + 1)])) \Rightarrow (\forall x P(x))$                                                                                                                                                                                            |

|      |                                                                                                                                                                                                                                                                                                                                                                                                                             |
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| Q.16 | <p>Consider the following statements:</p> <ul style="list-style-type: none"><li>(i) Address Resolution Protocol (ARP) provides a mapping from an IP address to the corresponding hardware (link-layer) address.</li><li>(ii) A single TCP segment from a sender S to a receiver R cannot carry both data from S to R and acknowledgement for a segment from R to S.</li></ul> <p>Which ONE of the following is CORRECT?</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                             |
| (A)  | Both (i) and (ii) are TRUE                                                                                                                                                                                                                                                                                                                                                                                                  |
| (B)  | (i) is TRUE and (ii) is FALSE                                                                                                                                                                                                                                                                                                                                                                                               |
| (C)  | (i) is FALSE and (ii) is TRUE                                                                                                                                                                                                                                                                                                                                                                                               |
| (D)  | Both (i) and (ii) are FALSE                                                                                                                                                                                                                                                                                                                                                                                                 |

| Q.17                        | <p>Consider the routing protocols given in <b>List I</b> and the names given in <b>List II</b>:</p> <table border="1"> <thead> <tr> <th>List I</th><th>List II</th></tr> </thead> <tbody> <tr> <td>(i) Distance vector routing</td><td>(a) Bellman-Ford</td></tr> <tr> <td>(ii) Link state routing</td><td>(b) Dijkstra</td></tr> </tbody> </table> <p>For matching of items in <b>List I</b> with those in <b>List II</b>, which ONE of the following options is CORRECT?</p> | List I | List II | (i) Distance vector routing | (a) Bellman-Ford | (ii) Link state routing | (b) Dijkstra |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------|-----------------------------|------------------|-------------------------|--------------|
| List I                      | List II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |         |                             |                  |                         |              |
| (i) Distance vector routing | (a) Bellman-Ford                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        |         |                             |                  |                         |              |
| (ii) Link state routing     | (b) Dijkstra                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |         |                             |                  |                         |              |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |         |                             |                  |                         |              |
| (A)                         | (i) – (a) and (ii) – (b)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |         |                             |                  |                         |              |
| (B)                         | (i) – (a) and (ii) – (a)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |         |                             |                  |                         |              |
| (C)                         | (i) – (b) and (ii) – (a)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |         |                             |                  |                         |              |
| (D)                         | (i) – (b) and (ii) – (b)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |         |                             |                  |                         |              |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |        |         |                             |                  |                         |              |



|      |                                                                                                                                                                                                 |
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| Q.18 | <p>A machine receives an IPv4 datagram. The protocol field of the IPv4 header has the protocol number of a protocol X.</p> <p>Which ONE of the following is NOT a possible candidate for X?</p> |
|      |                                                                                                                                                                                                 |
| (A)  | Internet Control Message Protocol (ICMP)                                                                                                                                                        |
| (B)  | Internet Group Management Protocol (IGMP)                                                                                                                                                       |
| (C)  | Open Shortest Path First (OSPF)                                                                                                                                                                 |
| (D)  | Routing Information Protocol (RIP)                                                                                                                                                              |
|      |                                                                                                                                                                                                 |



|      |                                                                                                                                                                                                                                                                                                                                                                                        |
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| Q.19 | <p>Consider the following C program:</p> <pre>#include &lt;stdio.h&gt;  void stringcopy(char *, char *);  int main(){      char a[30] = "@#Hello World!";      stringcopy(a, a + 2);      printf("%s\n", a);      return 0;  }  void stringcopy(char *s, char *t) {      while(*t)          *s++ = *t++;  }</pre> <p>Which ONE of the following will be the output of the program?</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                                        |
| (A)  | @#Hello World!                                                                                                                                                                                                                                                                                                                                                                         |
| (B)  | Hello World!                                                                                                                                                                                                                                                                                                                                                                           |
| (C)  | ello World!                                                                                                                                                                                                                                                                                                                                                                            |
| (D)  | Hello World!d!                                                                                                                                                                                                                                                                                                                                                                         |



|      |                                                                                                                                                                                                                                                                                                                                                                         |
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| Q.20 | <p>Consider an unordered list of <math>N</math> distinct integers.</p> <p>What is the minimum number of element comparisons required to find an integer in the list that is NOT the largest in the list?</p>                                                                                                                                                            |
|      |                                                                                                                                                                                                                                                                                                                                                                         |
| (A)  | 1                                                                                                                                                                                                                                                                                                                                                                       |
| (B)  | $N - 1$                                                                                                                                                                                                                                                                                                                                                                 |
| (C)  | $N$                                                                                                                                                                                                                                                                                                                                                                     |
| (D)  | $2N - 1$                                                                                                                                                                                                                                                                                                                                                                |
|      |                                                                                                                                                                                                                                                                                                                                                                         |
| Q.21 | <p>Consider the following statements about the use of backpatching in a compiler for intermediate code generation:</p> <p>(I) Backpatching can be used to generate code for Boolean expression in one pass.</p> <p>(II) Backpatching can be used to generate code for flow-of-control statements in one pass.</p> <p>Which ONE of the following options is CORRECT?</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                         |
| (A)  | Only (I) is correct.                                                                                                                                                                                                                                                                                                                                                    |
| (B)  | Only (II) is correct.                                                                                                                                                                                                                                                                                                                                                   |
| (C)  | Both (I) and (II) are correct.                                                                                                                                                                                                                                                                                                                                          |
| (D)  | Neither (I) nor (II) is correct.                                                                                                                                                                                                                                                                                                                                        |

|      |                                                                                                                                                                                                                                                                                                                                                                    |
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| Q.22 | <p>Given the following syntax directed translation rules:</p> <p>Rule 1: <math>R \rightarrow AB \{B.i = R.i - 1; A.i = B.i; R.i = A.i + 1;\}</math><br/> Rule 2: <math>P \rightarrow CD \{P.i = C.i + D.i; D.i = C.i + 2;\}</math><br/> Rule 3: <math>Q \rightarrow EF \{Q.i = E.i + F.i;\}</math></p> <p>Which ONE is the CORRECT option among the following?</p> |
| (A)  | Rule 1 is S-attributed and L-attributed; Rule 2 is S-attributed and not L-attributed; Rule 3 is neither S-attributed nor L-attributed                                                                                                                                                                                                                              |
| (B)  | Rule 1 is neither S-attributed nor L-attributed; Rule 2 is S-attributed and L-attributed; Rule 3 is S-attributed and L-attributed                                                                                                                                                                                                                                  |
| (C)  | Rule 1 is neither S-attributed nor L-attributed; Rule 2 is not S-attributed and is L-attributed; Rule 3 is S-attributed and L-attributed                                                                                                                                                                                                                           |
| (D)  | Rule 1 is S-attributed and not L-attributed; Rule 2 is not S-attributed and is L-attributed; Rule 3 is S-attributed and L-attributed                                                                                                                                                                                                                               |



|      |                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| Q.23 | <p>Consider a network that uses Ethernet and IPv4. Assume that IPv4 headers do not use any options field. Each Ethernet frame can carry a maximum of 1500 bytes in its data field. A UDP segment is transmitted. The payload (data) in the UDP segment is 7488 bytes.</p> <p>Which ONE of the following choices has the CORRECT total number of fragments transmitted and the size of the last fragment including IPv4 header?</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| (A)  | 5 fragments, 1488 bytes                                                                                                                                                                                                                                                                                                                                                                                                            |
| (B)  | 6 fragments, 88 bytes                                                                                                                                                                                                                                                                                                                                                                                                              |
| (C)  | 6 fragments, 108 bytes                                                                                                                                                                                                                                                                                                                                                                                                             |
| (D)  | 6 fragments, 116 bytes                                                                                                                                                                                                                                                                                                                                                                                                             |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Q.24 | <p>Which ONE of the following languages is accepted by a deterministic pushdown automaton?</p>                                                                                                                                                                                                                                                                                                                                     |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| (A)  | Any regular language.                                                                                                                                                                                                                                                                                                                                                                                                              |
| (B)  | Any context-free language.                                                                                                                                                                                                                                                                                                                                                                                                         |
| (C)  | Any language accepted by a non-deterministic pushdown automaton.                                                                                                                                                                                                                                                                                                                                                                   |
| (D)  | Any decidable language.                                                                                                                                                                                                                                                                                                                                                                                                            |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                    |

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.25 | <p>Let <math>G_1, G_2</math> be Context Free Grammars (CFGs) and <math>R</math> be a regular expression. For a grammar <math>G</math>, let <math>L(G)</math> denote the language generated by <math>G</math>.</p> <p>Which ONE among the following questions is decidable?</p>                                                                                                                                                             |
| (A)  | Is $L(G_1) = L(G_2)$ ?                                                                                                                                                                                                                                                                                                                                                                                                                     |
| (B)  | Is $L(G_1) \cap L(G_2) = \emptyset$ ?                                                                                                                                                                                                                                                                                                                                                                                                      |
| (C)  | Is $L(G_1) = L(R)$ ?                                                                                                                                                                                                                                                                                                                                                                                                                       |
| (D)  | Is $L(G_1) = \emptyset$ ?                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Q.26 | <p>Processes <math>P_1, P_2, P_3, P_4</math> arrive in that order at times 0, 1, 2, and 8 milliseconds respectively, and have execution times of 10, 13, 6, and 9 milliseconds respectively. Shortest Remaining Time First (SRTF) algorithm is used as the CPU scheduling policy. Ignore context switching times.</p> <p>Which ONE of the following correctly gives the average turnaround time of the four processes in milliseconds?</p> |
| (A)  | 22                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| (B)  | 15                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| (C)  | 37                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| (D)  | 19                                                                                                                                                                                                                                                                                                                                                                                                                                         |

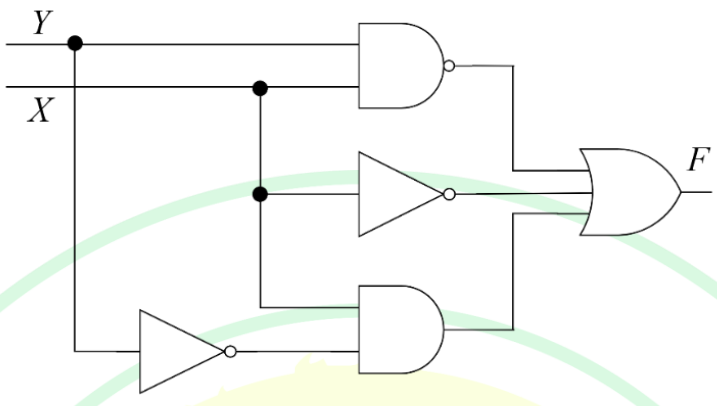


|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.27 | <p>An audit of a banking transactions system has found that on an earlier occasion, two joint holders of account <i>A</i> attempted simultaneous transfers of Rs. 10000 each from account <i>A</i> to account <i>B</i>. Both transactions read the same value, Rs. 11000, as the initial balance in <i>A</i> and were allowed to go through. <i>B</i> was credited Rs. 10000 twice. <i>A</i> was debited only once and ended up with a balance of Rs. 1000.</p> <p>Which of the following properties is/are certain to have been violated by the system?</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| (A)  | Atomicity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| (B)  | Consistency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| (C)  | Isolation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| (D)  | Durability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Q.28 | <p>Which of the following is/are part of an Instruction Set Architecture of a processor?</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| (A)  | The size of the cache memory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| (B)  | The clock frequency of the processor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| (C)  | The number of cache memory levels                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| (D)  | The total number of registers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |



|      |                                                                                                                                                                                  |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.29 | Which of the following statements regarding Breadth First Search (BFS) and Depth First Search (DFS) on an undirected simple graph $G$ is/are TRUE?                               |
|      |                                                                                                                                                                                  |
| (A)  | A DFS tree of $G$ is a Shortest Path tree of $G$ .                                                                                                                               |
| (B)  | Every non-tree edge of $G$ with respect to a DFS tree is a forward/back edge.                                                                                                    |
| (C)  | If $(u, v)$ is a non-tree edge of $G$ with respect to a BFS tree, then the distances from the source vertex $s$ to $u$ and $v$ in the BFS tree are within $\pm 1$ of each other. |
| (D)  | Both BFS and DFS can be used to find the connected components of $G$ .                                                                                                           |
|      |                                                                                                                                                                                  |

| Q.30                       | <p>Consider the two lists <b>List I</b> and <b>List II</b> given below:</p> <table border="1"> <thead> <tr> <th><b>List I</b></th><th><b>List II</b></th></tr> </thead> <tbody> <tr> <td>(i) Context free languages</td><td>(a) Closed under union</td></tr> <tr> <td>(ii) Recursive languages</td><td>(b) Not closed under complementation</td></tr> <tr> <td>(iii) Regular languages</td><td>(c) Closed under intersection</td></tr> </tbody> </table> <p>For matching of items in <b>List I</b> with those in <b>List II</b>, which of the following option(s) is/are CORRECT?</p> | <b>List I</b> | <b>List II</b> | (i) Context free languages | (a) Closed under union | (ii) Recursive languages | (b) Not closed under complementation | (iii) Regular languages | (c) Closed under intersection |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------|----------------------------|------------------------|--------------------------|--------------------------------------|-------------------------|-------------------------------|
| <b>List I</b>              | <b>List II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                |                            |                        |                          |                                      |                         |                               |
| (i) Context free languages | (a) Closed under union                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                |                            |                        |                          |                                      |                         |                               |
| (ii) Recursive languages   | (b) Not closed under complementation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |                |                            |                        |                          |                                      |                         |                               |
| (iii) Regular languages    | (c) Closed under intersection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |               |                |                            |                        |                          |                                      |                         |                               |
|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                |                            |                        |                          |                                      |                         |                               |
| (A)                        | (i) – (a), (ii) – (b), and (iii) – (c)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                |                            |                        |                          |                                      |                         |                               |
| (B)                        | (i) – (b), (ii) – (a), and (iii) – (c)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                |                            |                        |                          |                                      |                         |                               |
| (C)                        | (i) – (b), (ii) – (c), and (iii) – (a)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                |                            |                        |                          |                                      |                         |                               |
| (D)                        | (i) – (a), (ii) – (c), and (iii) – (b)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                |                            |                        |                          |                                      |                         |                               |
|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                |                            |                        |                          |                                      |                         |                               |

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| Q.31 | <p>Consider the following logic circuit diagram.</p>  <p>Which is/are the CORRECT option(s) for the output function <math>F</math>?</p>                                                                                    |
| (A)  | $\bar{X}\bar{Y}$                                                                                                                                                                                                                                                                                             |
| (B)  | $\bar{X} + \bar{Y} + X\bar{Y}$                                                                                                                                                                                                                                                                               |
| (C)  | $\bar{X}\bar{Y} + \bar{X} + X\bar{Y}$                                                                                                                                                                                                                                                                        |
| (D)  | $X + \bar{Y}$                                                                                                                                                                                                                                                                                                |
|      |                                                                                                                                                                                                                                                                                                              |
| Q.32 | <p>The following two signed 2's complement numbers (multiplicand M and multiplier Q) are being multiplied using Booth's algorithm:</p> <p>M: 1100 1101 1110 1101 and Q: 1010 0100 1010 1010</p> <p>The total number of addition and subtraction operations to be performed is _____. (Answer in integer)</p> |
|      |                                                                                                                                                                                                                                                                                                              |

|      |                                                                                                                                                                                                                                                                                                                     |
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| Q.33 | <pre>int x=126,y=105; do {     if(x&gt;y) x=x-y;     else y=y-x; } while(x!=y);  printf("%d",x);</pre> <p>The output of the given C code segment is _____. (Answer in integer)</p>                                                                                                                                  |
| Q.34 | <p>In a 4-bit ripple counter, if the period of the waveform at the last flip-flop is 64 microseconds, then the frequency of the ripple counter in kHz is _____. (Answer in integer)</p>                                                                                                                             |
| Q.35 | <p>Suppose the values 10, -4, 15, 30, 20, 5, 60, 19 are inserted in that order into an initially empty binary search tree. Let <math>T</math> be the resulting binary search tree. The number of edges in the path from the node containing 19 to the root node of <math>T</math> is _____. (Answer in integer)</p> |



**Q.36 – Q.65 Carry TWO marks Each**

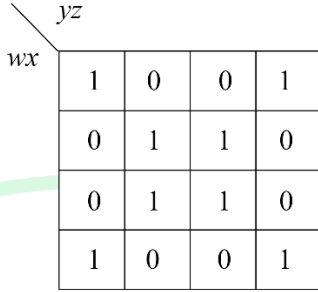
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.36 | Suppose we are transmitting frames between two nodes using Stop-and-Wait protocol. The frame size is 3000 bits. The transmission rate of the channel is 2000 bps (bits/second) and the propagation delay between the two nodes is 100 milliseconds. Assume that the processing times at the source and destination are negligible. Also, assume that the size of the acknowledgement packet is negligible. Which ONE of the following most accurately gives the channel utilization for the above scenario in percentage? |
| (A)  | 88.23                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| (B)  | 93.75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| (C)  | 85.44                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| (D)  | 66.67                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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| Q.37 | <p>Let <math>G</math> be an edge-weighted undirected graph with positive edge weights. Suppose a positive constant <math>\alpha</math> is added to the weight of every edge.</p> <p>Which ONE of the following statements is TRUE about the minimum spanning trees (MSTs) and shortest paths (SPs) in <math>G</math> before and after the edge weight update?</p> |
| (A)  | Every MST remains an MST, and every SP remains an SP.                                                                                                                                                                                                                                                                                                             |
| (B)  | MSTs need not remain MSTs, and every SP remains an SP.                                                                                                                                                                                                                                                                                                            |
| (C)  | Every MST remains an MST, and SPs need not remain SPs.                                                                                                                                                                                                                                                                                                            |
| (D)  | MSTs need not remain MSTs, and SPs need not remain SPs.                                                                                                                                                                                                                                                                                                           |

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.38 | <p>A meld operation on two instances of a data structure combines them into one single instance of the same data structure. Consider the following data structures:</p> <p>P: Unsorted doubly linked list with pointers to the head node and tail node of the list.</p> <p>Q: Min-heap implemented using an array.</p> <p>R: Binary Search Tree.</p> <p>Which ONE of the following options gives the worst-case time complexities for meld operation on instances of size <math>n</math> of these data structures?</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| (A)  | P: $\Theta(1)$ , Q: $\Theta(n)$ , R: $\Theta(n)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| (B)  | P: $\Theta(1)$ , Q: $\Theta(n \log n)$ , R: $\Theta(n)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| (C)  | P: $\Theta(n)$ , Q: $\Theta(n \log n)$ , R: $\Theta(n^2)$                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| (D)  | P: $\Theta(1)$ , Q: $\Theta(n)$ , R: $\Theta(n \log n)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|      |                                                                                                                                                                                                                                                                                                                                                                                                       |
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| Q.39 | <p>For a direct-mapped cache, 4 bits are used for the tag field and 12 bits are used to index into a cache block. The size of each cache block is one byte. Assume that there is no other information stored for each cache block.</p> <p>Which ONE of the following is the CORRECT option for the sizes of the main memory and the cache memory in this system (byte addressable), respectively?</p> |
| (A)  | 64 KB and 4 KB                                                                                                                                                                                                                                                                                                                                                                                        |
| (B)  | 128 KB and 16 KB                                                                                                                                                                                                                                                                                                                                                                                      |
| (C)  | 64 KB and 8 KB                                                                                                                                                                                                                                                                                                                                                                                        |
| (D)  | 128 KB and 6 KB                                                                                                                                                                                                                                                                                                                                                                                       |
| Q.40 | <p>Given a Context-Free Grammar <math>G</math> as follows:</p> $S \rightarrow Aa \mid bAc \mid dc \mid bda$ $A \rightarrow d$ <p>Which ONE of the following statements is TRUE?</p>                                                                                                                                                                                                                   |
| (A)  | $G$ is neither LALR(1) nor SLR(1)                                                                                                                                                                                                                                                                                                                                                                     |
| (B)  | $G$ is CLR(1), not LALR(1)                                                                                                                                                                                                                                                                                                                                                                            |
| (C)  | $G$ is LALR(1), not SLR(1)                                                                                                                                                                                                                                                                                                                                                                            |
| (D)  | $G$ is LALR(1), also SLR(1)                                                                                                                                                                                                                                                                                                                                                                           |

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| Q.41 | <p>An array <math>A</math> of length <math>n</math> with distinct elements is said to be bitonic if there is an index <math>1 \leq i \leq n</math> such that <math>A[1..i]</math> is sorted in the non-decreasing order and <math>A[i+1..n]</math> is sorted in the non-increasing order.</p> <p>Which ONE of the following represents the best possible asymptotic bound for the worst-case number of comparisons by an algorithm that searches for an element in a bitonic array <math>A</math>?</p> |
| (A)  | $\Theta(n)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| (B)  | $\Theta(1)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| (C)  | $\Theta(\log^2 n)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| (D)  | $\Theta(\log n)$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Q.42 | <p>Let <math>\mathcal{F}</math> be the set of all functions from <math>\{1, \dots, n\}</math> to <math>\{0,1\}</math>. Define the binary relation <math>\preceq</math> on <math>\mathcal{F}</math> as follows:</p> <p><math>\forall f, g \in \mathcal{F}, f \preceq g</math> if and only if <math>\forall x \in \{1, \dots, n\}, f(x) \leq g(x)</math>, where <math>0 \leq 1</math>.</p> <p>Which of the following statement(s) is/are TRUE?</p>                                                       |
| (A)  | $\preceq$ is a symmetric relation                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| (B)  | $(\mathcal{F}, \preceq)$ is a partial order                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| (C)  | $(\mathcal{F}, \preceq)$ is a lattice                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| (D)  | $\preceq$ is an equivalence relation                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

|      |                                                                                                                                                                                                                                                                                                                     |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.43 | <p>Given the following Karnaugh Map for a Boolean function <math>F(w, x, y, z)</math>:</p> <div style="text-align: center;">  </div> <p>Which one or more of the following Boolean expression(s) represent(s) <math>F</math>?</p> |
|      |                                                                                                                                                                                                                                                                                                                     |
| (A)  | $\bar{w}\bar{x}\bar{y}\bar{z} + w\bar{x}\bar{y}\bar{z} + \bar{w}\bar{x}y\bar{z} + w\bar{x}y\bar{z} + xz$                                                                                                                                                                                                            |
| (B)  | $\bar{w}\bar{x}\bar{y}\bar{z} + \bar{w}\bar{x}y\bar{z} + w\bar{x}yz + xz$                                                                                                                                                                                                                                           |
| (C)  | $\bar{w}\bar{x}\bar{y}\bar{z} + w\bar{x}\bar{y}\bar{z} + w\bar{x}\bar{y}z + xz$                                                                                                                                                                                                                                     |
| (D)  | $\bar{x}\bar{z} + xz$                                                                                                                                                                                                                                                                                               |
|      |                                                                                                                                                                                                                                                                                                                     |

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.44 | <p>Consider a system of linear equations <math>PX = Q</math> where <math>P \in \mathbb{R}^{3 \times 3}</math> and <math>Q \in \mathbb{R}^{3 \times 1}</math>. Suppose <math>P</math> has an LU decomposition, <math>P = LU</math>, where</p> $L = \begin{bmatrix} 1 & 0 & 0 \\ l_{21} & 1 & 0 \\ l_{31} & l_{32} & 1 \end{bmatrix} \text{ and } U = \begin{bmatrix} u_{11} & u_{12} & u_{13} \\ 0 & u_{22} & u_{23} \\ 0 & 0 & u_{33} \end{bmatrix}.$ <p>Which of the following statement(s) is/are TRUE?</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| (A)  | The system $PX = Q$ can be solved by first solving $LY = Q$ and then $UX = Y$ .                                                                                                                                                                                                                                                                                                                                                                                                                               |
| (B)  | If $P$ is invertible, then both $L$ and $U$ are invertible.                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| (C)  | If $P$ is singular, then at least one of the diagonal elements of $U$ is zero.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| (D)  | If $P$ is symmetric, then both $L$ and $U$ are symmetric.                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.45 | <p>Consider a stack data structure into which we can PUSH and POP records. Assume that each record pushed in the stack has a positive integer key and that all keys are distinct.</p> <p>We wish to augment the stack data structure with an <math>O(1)</math> time MIN operation that returns a pointer to the record with smallest key present in the stack</p> <ol style="list-style-type: none"> <li>1) without deleting the corresponding record, and</li> <li>2) without increasing the complexities of the standard stack operations.</li> </ol> <p>Which one or more of the following approach(es) can achieve it?</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| (A)  | Keep with every record in the stack, a pointer to the record with the smallest key below it.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| (B)  | Keep a pointer to the record with the smallest key in the stack.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| (C)  | Keep an auxiliary array in which the key values of the records in the stack are maintained in sorted order.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| (D)  | Keep a Min-Heap in which the key values of the records in the stack are maintained.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

|      |                                                                                                                                                                                                                                                                                                                                                                    |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.46 | <p>Consider the following relational schema along with all the functional dependencies that hold on them.</p> <p><math>R1(A, B, C, D, E): \{ D \rightarrow E, EA \rightarrow B, EB \rightarrow C \}</math></p> <p><math>R2(A, B, C, D): \{ A \rightarrow D, A \rightarrow B, C \rightarrow A \}</math></p> <p>Which of the following statement(s) is/are TRUE?</p> |
| (A)  | $R1$ is in 3NF                                                                                                                                                                                                                                                                                                                                                     |
| (B)  | $R2$ is in 3NF                                                                                                                                                                                                                                                                                                                                                     |
| (C)  | $R1$ is NOT in 3NF                                                                                                                                                                                                                                                                                                                                                 |
| (D)  | $R2$ is NOT in 3NF                                                                                                                                                                                                                                                                                                                                                 |

Q.47

Consider a demand paging system with three frames, and the following page reference string: 1 2 3 4 5 4 1 6 4 5 1 3 2. The contents of the frames are as follows initially and after each reference (from left to right):

| <i>initially</i> | <i>after</i> |    |    |    |    |   |   |    |   |   |    |    |    |
|------------------|--------------|----|----|----|----|---|---|----|---|---|----|----|----|
| -                | 1*           | 2* | 3* | 4* | 5* | 4 | 1 | 6* | 4 | 5 | 1* | 3* | 2* |
| -                | 1            | 1  | 1  | 1  | 1  | 1 | 1 | 6  | 6 | 6 | 6  | 6  | 2  |
| -                | -            | 2  | 2  | 4  | 4  | 4 | 4 | 4  | 4 | 4 | 1  | 1  | 1  |
| -                | -            | -  | 3  | 3  | 5  | 5 | 5 | 5  | 5 | 5 | 5  | 3  | 3  |

The \*-marked references cause page replacements.

Which one or more of the following could be the page replacement policy/policies in use?

(A)

Least Recently Used page replacement policy

(B)

Least Frequently Used page replacement policy

(C)

Most Frequently Used page replacement policy

(D)

Optimal page replacement policy

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.48 | <p><math>P = \{P_1, P_2, P_3, P_4\}</math> consists of all active processes in an operating system.<br/> <math>R = \{R_1, R_2, R_3, R_4\}</math> consists of single instances of distinct types of resources in the system.</p> <p>The resource allocation graph has the following assignment and claim edges.</p> <p>Assignment edges: <math>R_1 \rightarrow P_1, R_2 \rightarrow P_2, R_3 \rightarrow P_3, R_4 \rightarrow P_4</math> (the assignment edge <math>R_1 \rightarrow P_1</math> means resource <math>R_1</math> is assigned to process <math>P_1</math>, and so on for others)</p> <p>Claim edges: <math>P_1 \rightarrow R_2, P_2 \rightarrow R_3, P_3 \rightarrow R_1, P_2 \rightarrow R_4, P_4 \rightarrow R_2</math> (the claim edge <math>P_1 \rightarrow R_2</math> means process <math>P_1</math> is waiting for resource <math>R_2</math>, and so on for others)</p> <p>Which of the following statement(s) is/are CORRECT?</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| (A)  | Aborting $P_1$ makes the system deadlock free.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| (B)  | Aborting $P_3$ makes the system deadlock free.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| (C)  | Aborting $P_2$ makes the system deadlock free.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| (D)  | Aborting $P_1$ and $P_4$ makes the system deadlock free.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|      |                                                                                                                                                                                                                                                                                                                                                                                        |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.49 | <p>Three floating point numbers <math>X, Y</math>, and <math>Z</math> are stored in three registers <math>R_X, R_Y</math>, and <math>R_Z</math>, respectively in IEEE 754 single precision format as given below in hexadecimal:</p> <p><math>R_X = 0xC1100000, R_Y = 0x40C00000</math>, and <math>R_Z = 0x41400000</math></p> <p>Which of the following option(s) is/are CORRECT?</p> |
| (A)  | $4(X + Y) + Z = 0$                                                                                                                                                                                                                                                                                                                                                                     |
| (B)  | $2Y - Z = 0$                                                                                                                                                                                                                                                                                                                                                                           |
| (C)  | $4X + 3Z = 0$                                                                                                                                                                                                                                                                                                                                                                          |
| (D)  | $X + Y + Z = 0$                                                                                                                                                                                                                                                                                                                                                                        |
| Q.50 | <p>Which of the following Boolean algebraic equation(s) is/are CORRECT?</p>                                                                                                                                                                                                                                                                                                            |
| (A)  | $\bar{A} B C + A \bar{B} \bar{C} + \bar{A} \bar{B} \bar{C} + A \bar{B} C + A B C = B C + \bar{B} \bar{C} + \bar{A} \bar{B}$                                                                                                                                                                                                                                                            |
| (B)  | $A B + \bar{A} C + B C = A B + \bar{A} C$                                                                                                                                                                                                                                                                                                                                              |
| (C)  | $(A + C) (\bar{A} + B) = A B + \bar{A} C$                                                                                                                                                                                                                                                                                                                                              |
| (D)  | $\overline{(A + \bar{B} + \bar{D}) (C + D) (\bar{A} + C + D) (A + B + \bar{D})} = \bar{A} D + \bar{C} \bar{D}$                                                                                                                                                                                                                                                                         |

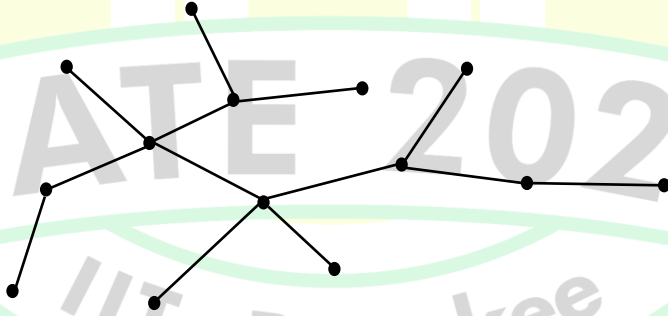
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.51 | <p>Consider two grammars <math>G_1</math> and <math>G_2</math> with the production rules given below:</p> $G_1: S \rightarrow \text{if } E \text{ then } S \mid \text{if } E \text{ then } S \text{ else } S \mid a$ $E \rightarrow b$ $G_2: S \rightarrow \text{if } E \text{ then } S \mid M$ $M \rightarrow \text{if } E \text{ then } M \text{ else } S \mid c$ $E \rightarrow b$ <p>where <i>if</i>, <i>then</i>, <i>else</i>, <i>a</i>, <i>b</i>, <i>c</i> are the terminals.</p> <p>Which of the following option(s) is/are CORRECT?</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| (A)  | $G_1$ is not $LL(1)$ and $G_2$ is $LL(1)$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| (B)  | $G_1$ is $LL(1)$ and $G_2$ is not $LL(1)$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| (C)  | $G_1$ and $G_2$ are not $LL(1)$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| (D)  | $G_1$ and $G_2$ are ambiguous.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

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| Q.52 | <p>Let <math>\Sigma = \{a, b, c\}</math>. For <math>x \in \Sigma^*</math>, and <math>\alpha \in \Sigma</math>, let <math>\#_{\alpha}(x)</math> denote the number of occurrences of <math>\alpha</math> in <math>x</math>.</p> <p>Which one or more of the following option(s) define(s) regular language(s)?</p> |
| (A)  | $\{a^m b^n \mid m, n \geq 0\}$                                                                                                                                                                                                                                                                                   |
| (B)  | $\{a, b\}^* \cap \{a^m b^n c^{m-n} \mid m \geq n \geq 0\}$                                                                                                                                                                                                                                                       |
| (C)  | $\{w \mid w \in \{a, b\}^*, \#_a(w) \equiv 2 \pmod{7}, \text{ and } \#_b(w) \equiv 3 \pmod{9}\}$                                                                                                                                                                                                                 |
| (D)  | $\{w \mid w \in \{a, b\}^*, \#_a(w) \equiv 2 \pmod{7}, \text{ and } \#_a(w) = \#_b(w)\}$                                                                                                                                                                                                                         |
|      |                                                                                                                                                                                                                                                                                                                  |

|      |                                                                                                                                                                         |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.53 | Consider the database transactions T1 and T2, and data items X and Y. Which of the schedule(s) is/are conflict serializable?                                            |
|      | <div> <b>Transaction T1</b><br/> R1(X)<br/> W1(Y)<br/> R1(X)<br/> W1(X)<br/> COMMIT(T1) </div> <div> <b>Transaction T2</b><br/> W2(X)<br/> W2(Y)<br/> COMMIT(T2) </div> |
|      |                                                                                                                                                                         |
| (A)  | R1(X), W2(X), W1(Y), W2(Y), R1(X), W1(X), COMMIT(T2), COMMIT(T1)                                                                                                        |
| (B)  | W2(X), R1(X), W2(Y), W1(Y), R1(X), COMMIT(T2), W1(X), COMMIT(T1)                                                                                                        |
| (C)  | R1(X), W1(Y), W2(X), W2(Y), R1(X), W1(X), COMMIT(T1), COMMIT(T2)                                                                                                        |
| (D)  | W2(X), R1(X), W1(Y), W2(Y), R1(X), COMMIT(T2), W1(X), COMMIT(T1)                                                                                                        |
|      |                                                                                                                                                                         |

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.54 | <p>Consider the following relational schema:</p> <p>Students (<u>rollno</u>: integer, name: string, age: integer, cgpa: real)</p> <p>Courses (<u>courseno</u>: integer, cname: string, credits: integer)</p> <p>Enrolled (<u>rollno</u>: integer, <u>courseno</u>: integer, grade: string)</p> <p>Which of the following options is/are correct SQL query/queries to retrieve the names of the students enrolled in course number (i.e., courseno) 1470?</p> |
| (A)  | <pre>SELECT S.name FROM Students S WHERE EXISTS (SELECT * FROM Enrolled E               WHERE E.courseno = 1470                  AND E.rollno = S.rollno);</pre>                                                                                                                                                                                                                                                                                             |
| (B)  | <pre>SELECT S.name FROM Students S WHERE SIZEOF (SELECT * FROM Enrolled E               WHERE E.courseno = 1470                  AND E.rollno = S.rollno) &gt; 0;</pre>                                                                                                                                                                                                                                                                                      |
| (C)  | <pre>SELECT S.name FROM Students S WHERE 0 &lt; (SELECT COUNT(*)            FROM Enrolled E            WHERE E.courseno = 1470               AND E.rollno = S.rollno);</pre>                                                                                                                                                                                                                                                                                 |
| (D)  | <pre>SELECT S.name FROM Students S NATURAL JOIN Enrolled E WHERE E.courseno = 1470;</pre>                                                                                                                                                                                                                                                                                                                                                                    |

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| Q.55 | <p>Given a computing system with two levels of cache (L1 and L2) and a main memory. The first level (L1) cache access time is 1 nanosecond (ns) and the “hit rate” for L1 cache is 90% while the processor is accessing the data from L1 cache. Whereas, for the second level (L2) cache, the “hit rate” is 80% and the “miss penalty” for transferring data from L2 cache to L1 cache is 10 ns. The “miss penalty” for the data to be transferred from main memory to L2 cache is 100 ns.</p> <p>Then the average memory access time in this system in nanoseconds is _____. (rounded off to one decimal place)</p>                                                                                                                                                                                        |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Q.56 | <p>A 5-stage instruction pipeline has stage delays of 180, 250, 150, 170, and 250, respectively, in nanoseconds. The delay of an inter-stage latch is 10 nanoseconds. Assume that there are no pipeline stalls due to branches and other hazards. The time taken to process 1000 instructions in microseconds is _____. (rounded off to two decimal places)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Q.57 | <p>In a <math>B^+</math>-tree where each node can hold at most four key values, a root to leaf path consists of the following nodes:</p> <p style="text-align: center;"><math>A = (49, 77, 83, -)</math>, <math>B = (7, 19, 33, 44)</math>, <math>C = (20^*, 22^*, 25^*, 26^*)</math></p> <p>The *-marked keys signify that these are data entries in a leaf.</p> <p>Assume that a pointer between keys <math>k_1</math> and <math>k_2</math> points to a subtree containing keys in <math>[k_1, k_2)</math>, and that when a leaf is created, the smallest key in it is copied up into its parent.</p> <p>A record with key value 23 is inserted into the <math>B^+</math>-tree.</p> <p>The smallest key value in the parent of the leaf that contains <math>25^*</math> is _____. (Answer in integer)</p> |

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.58 | <p>A computer system supports a logical address space of <math>2^{32}</math> bytes. It uses two-level hierarchical paging with a page size of 4096 bytes. A logical address is divided into a <math>b</math>-bit index to the outer page table, an offset within the page of the inner page table, and an offset within the desired page. Each entry of the inner page table uses eight bytes. All the pages in the system have the same size.</p> <p>The value of <math>b</math> is _____. (Answer in integer)</p>                                                                                                                                                                                                                                                                                                                                       |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Q.59 | <p>Consider the following algorithm <code>someAlgo</code> that takes an undirected graph <math>G</math> as input.</p> <pre>someAlgo(<math>G</math>)</pre> <ol style="list-style-type: none"> <li>1. Let <math>v</math> be any vertex in <math>G</math>. Run BFS on <math>G</math> starting at <math>v</math>. Let <math>u</math> be a vertex in <math>G</math> at maximum distance from <math>v</math> as given by the BFS.</li> <li>2. Run BFS on <math>G</math> again with <math>u</math> as the starting vertex. Let <math>z</math> be the vertex at maximum distance from <math>u</math> as given by the BFS.</li> <li>3. Output the distance between <math>u</math> and <math>z</math> in <math>G</math>.</li> </ol> <p>The output of <code>someAlgo(<math>T</math>)</code> for the tree shown in the given figure is _____. (Answer in integer)</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| Q.60             | <p>Let <math>\Sigma = \{1,2,3,4\}</math>. For <math>x \in \Sigma^*</math>, let <math>prod(x)</math> be the product of symbols in <math>x</math> modulo 7. We take <math>prod(\epsilon) = 1</math>, where <math>\epsilon</math> is the null string.</p> <p>For example, <math>prod(124) = (1 \times 2 \times 4) \bmod 7 = 1</math>.</p> <p>Define <math>L = \{x \in \Sigma^* \mid prod(x) = 2\}</math>.</p> <p>The number of states in a minimum state DFA for <math>L</math> is _____. (Answer in integer)</p>                                                                                                                                                                                                                 |                                 |                                             |                                 |        |   |                    |      |   |                    |       |   |                    |            |   |                    |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------------------------------|---------------------------------|--------|---|--------------------|------|---|--------------------|-------|---|--------------------|------------|---|--------------------|
|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                 |                                             |                                 |        |   |                    |      |   |                    |       |   |                    |            |   |                    |
| Q.61             | <p>An application executes <math>6.4 \times 10^8</math> number of instructions in 6.3 seconds. There are four types of instructions, the details of which are given in the table. The duration of a clock cycle in nanoseconds is _____. (rounded off to one decimal place)</p> <table><tr><th>Instruction type</th><th>Clock cycles required per instruction (CPI)</th><th>Number of instructions executed</th></tr><tr><td>Branch</td><td>2</td><td><math>2.25 \times 10^8</math></td></tr><tr><td>Load</td><td>5</td><td><math>1.20 \times 10^8</math></td></tr><tr><td>Store</td><td>4</td><td><math>1.65 \times 10^8</math></td></tr><tr><td>Arithmetic</td><td>3</td><td><math>1.30 \times 10^8</math></td></tr></table> | Instruction type                | Clock cycles required per instruction (CPI) | Number of instructions executed | Branch | 2 | $2.25 \times 10^8$ | Load | 5 | $1.20 \times 10^8$ | Store | 4 | $1.65 \times 10^8$ | Arithmetic | 3 | $1.30 \times 10^8$ |
| Instruction type | Clock cycles required per instruction (CPI)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Number of instructions executed |                                             |                                 |        |   |                    |      |   |                    |       |   |                    |            |   |                    |
| Branch           | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | $2.25 \times 10^8$              |                                             |                                 |        |   |                    |      |   |                    |       |   |                    |            |   |                    |
| Load             | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | $1.20 \times 10^8$              |                                             |                                 |        |   |                    |      |   |                    |       |   |                    |            |   |                    |
| Store            | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | $1.65 \times 10^8$              |                                             |                                 |        |   |                    |      |   |                    |       |   |                    |            |   |                    |
| Arithmetic       | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | $1.30 \times 10^8$              |                                             |                                 |        |   |                    |      |   |                    |       |   |                    |            |   |                    |
|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                 |                                             |                                 |        |   |                    |      |   |                    |       |   |                    |            |   |                    |

Q.62

Consider the following C program:

```
#include <stdio.h>

int main(){

    int a;

    int arr[5] = {30,50,10};

    int *ptr;

    ptr = &arr[0] + 1;

    a = *ptr;

    (*ptr)++;

    ptr++;

    printf("%d", a + (*ptr) + arr[1]);

    return 0;

}
```

The output of the above program is \_\_\_\_\_. (Answer in integer)

GATE 2025

IIT Roorkee

|      |                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| Q.63 | <p>Consider the following C program:</p> <pre>#include &lt;stdio.h&gt;  int g(int n) {     return (n+10); }  int f(int n) {     return g(n*2); }  int main() {     int sum, n;     sum=0;     for (n=1; n&lt;3; n++)         sum += g(f(n));     printf ("%d", sum);     return 0; }</pre> <p>The output of the given C program is _____. (Answer in integer)</p>                                               |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Q.64 | <p>A quadratic polynomial <math>(x - \alpha)(x - \beta)</math> over complex numbers is said to be square invariant if <math>(x - \alpha)(x - \beta) = (x - \alpha^2)(x - \beta^2)</math>. Suppose from the set of all square invariant quadratic polynomials we choose one at random.</p> <p>The probability that the roots of the chosen polynomial are equal is _____. (rounded off to one decimal place)</p> |
|      |                                                                                                                                                                                                                                                                                                                                                                                                                 |



|      |                                                                                                                                                                                                                                                                                                 |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Q.65 | <p>The unit interval <math>(0,1)</math> is divided at a point chosen uniformly distributed over <math>(0,1)</math> in <math>\mathbb{R}</math> into two disjoint subintervals.</p> <p>The expected length of the subinterval that contains 0.4 is _____. (rounded off to two decimal places)</p> |
|      |                                                                                                                                                                                                                                                                                                 |

