



**GATE
2025**

Computer Science & IT Shift-2

Memory based
Questions & Solutions

Exam held on
01/02/2025 (Afternoon Session)

SECTION - A

GENERAL APTITUDE

Q.1 Bird : Nest : Bee : _____

- (a) Hive
- (b) Kennel
- (c) Lair
- (d) Hammock

Ans. (a)

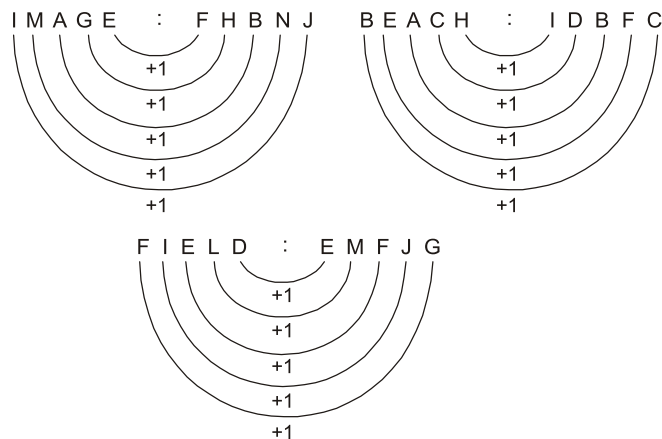
Bee : Hive
Dog : Kennel
Lair : Wild animal

End of Solution

Q.2 If IMAGE and FIELD are coded as FHB NJ and EMF JG then for BEACH is

- (a) JGIBC
- (b) IDBFC
- (c) CEADD
- (d) IBCEC

Ans. (b)



End of Solution

Q.3 $Pe^x = Qe^{-x}$, then the value of P and Q is if x is real.

- (a) $P = Q = 0$
- (b) $P = 1, Q = 1$
- (c) $P = 1, Q = -1$
- (d) $P = -1, Q = 1$

Ans. (a)

$$Pe^x = Qe^{-x}$$

(d) $\frac{P}{Q} \neq 0$

(b) $P = 1, Q = 1$ is not possible

(c) $P = 1, Q = -1$ is not possible.

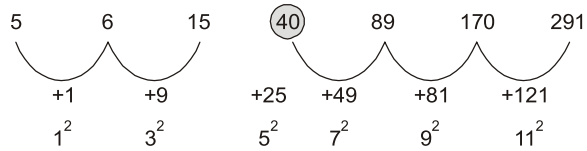
End of Solution

Q.4 Look at this series:

5, 6, 15, ____?____, 89, 170, 291

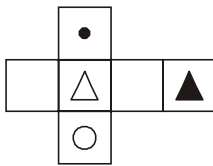
What number should come in place of?

Ans. (40)

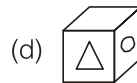
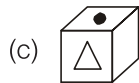
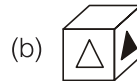
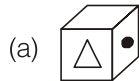


End of Solution

Q.5



Result not possible after folding it.



Ans. (b)

End of Solution





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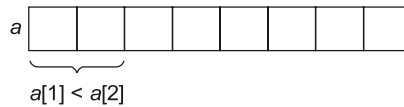
SECTION - B

TECHNICAL

Q.6 How many comparisons required to find the element which is not the maximum for given n distinct elements array.

- (a) $2n - 1$ (b) 1
(c) $\frac{3n}{2} - 2$ (d) $n - 1$

Ans. (b)



End of Solution

Q.7 How many number of nodes in T, that exactly two children for the tree with n nodes? [Each node 0 or 2 childs]

- (a) $\frac{(n-1)}{2}$ (b) $\frac{(n+1)}{2}$
(c) $\frac{n}{2}$ (d) $\frac{(n-2)}{2}$

Ans. (a)

Number of nodes (n)

Number of nodes of degree 2

- 1
3
5

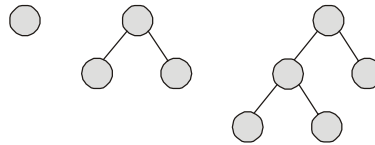
n

0

1

2

$\frac{n-1}{2}$



End of Solution

Q.8 What is Time complexity to find peak element in Array of n elements with elements increased order and followed by elements in decreasing order?

- (a) $\theta(n)$ (b) $\theta(1)$
 (c) $\theta(\log n)$ (d) $\theta(\log \log n)$

Ans. (c)

	1	2	3	4	5	6	7	8	9	10
a	4	6	8	10	12	15	18	12	8	7

Use binary search

low = 1; high = n ;

while (low \leq high)

```

{
    m = (low + high)/2;
    if (a[mid - 1] < a[mid] < a[mid + 1])
        low = k
    else if (a[mid - 1] > a[mid] > a[mid + 1])
        high = mid - 1;
    else if (a[mid - 1] < a[mid] > a[mid + 1])
        return (mid);
}
    
```

End of Solution

Q.9 Consider A, B, C, D, E attributes of relations R_1, R_2 with FD sets

$R_1 : \{D \rightarrow E, EA \rightarrow B, EB \rightarrow C\}$

$R_2 : \{A \rightarrow B, B \rightarrow D, C \rightarrow A\}$

Which is/are correct?

- (a) R_1 is in 3NF (b) R_1 is not in 3NF
 (c) R_2 is in 3NF (d) R_2 is not in 3NF

Ans. (b, d)

$R_1 : \{D \rightarrow E, EA \rightarrow B, EB \rightarrow C\}$ AD (AD)⁺ = {ADEBC} 1NF but not in 2NF

$R_2 : \{A \rightarrow B, B \rightarrow D, C \rightarrow A\}$ CE (CE)⁺ = {CEABD} 1NF but not in 2NF

$R_2(ABCD)$ C

{A \rightarrow B, B \rightarrow D, C \rightarrow A}

2NF but not 3NF.

End of Solution

- Q.10** Link state routing and distance vector routing protocol Bellman Ford and Dijkstra matched
 (a) Link state - Bellman Ford (b) Link state - Dijkstra
 (c) DVR - Bellman Ford (d) DVR - Dijkstra

[MSQ]

Ans. (b, c)

End of Solution

- Q.11** Calculate the total number of fragment and last payload.
 Payload : 7488 Bytes

MTU : 1500 B

- (a) 6, 116 (b) 6, 88
 (c) 6, 92 (d) 5, 88

Ans. (b)

6 fragments

Last payload = 88 Bytes

End of Solution

- Q.12** Frame length = 3000 bits
 Bandwidth (BW) = 2000 bps
 Pd = 100 ms
 Find efficiency (%) = ?
 Using stop and wait ARQ protocol.

Ans. (88.23%)

$$T_T = \frac{3000 \text{ bits}}{2000 \text{ bits/sec}} = \frac{3}{2}$$

$$L_U = \frac{\frac{3}{2}}{\frac{3}{2} + 2 \times 100 \times 10^{-6}} \times 100\%$$

$$= \frac{3}{3.4} \times 100\% = 0.8823 = 88.23\%$$

End of Solution

- Q.13** IPv4 packet has protocol field “x”. The number of “x” cannot be assigned to
 (a) IGMP (b) ICMP
 (c) RIP (d) OSPF

Ans. (c)

End of Solution

- Q.14** Consider two level cache organization with a respective hit ratios of 90% and 80% having the respective access times of 1 ns and 10 ns. Main memory access time is 100 ns. What is the average memory access time.

Ans. (4)

$$\begin{aligned} T_{\text{avg}} &= H_1 T_1 + (1 - H_1) H_2 (T_2 + T_1) + (1 - H_1) (1 - H_2) H_3 (T_3 + T_2 + T_1) \\ &= (0.9 \times 1) + (1 - 0.9) 0.8 (10 + 1) + (1 - 0.9) (1 - 0.8) (100 + 10 + 1) \\ &= 0.9 + 0.88 + 2.22 = 4 \text{ ns} \end{aligned}$$

End of Solution

- Q.15** Consider 5 stage pipeline with a respective delays of 150 ns, 250 ns, 250 ns, 160 ns and 170 ns. Buffer delay used between the stages have a delay of 10 ns. Execution time of 1000 instructions in the pipeline is _____. (in μsec)

Ans. (261.04)

$$\begin{aligned} K &= 5 \\ n &= 1000 \text{ (finite)} \\ t_p &= \max(\text{Stage Delay} + \text{Buffer Delay}) \\ &= 260 \text{ ns} \\ ET &= (K + n - 1) t_p \\ &= (5 + 1000 - 1) 260 \text{ ns} \\ &= 261040 \text{ ns} \\ &= 261.04 \mu\text{sec} \end{aligned}$$

End of Solution

- Q.16** Included in instruction set architecture?
- (a) Number of registers
 - (b) Clock cycle time or CPU clk frequency
 - (c) Number of cache levels
 - (d) Cache size

[MSQ]

Ans. (a, b)

Here, cache design is not considered in the ISA.

End of Solution

- Q.17** Consider cache index of 12 bits and 4 bit tag size main memory and cache memory size in (KB) respectively _____?

Ans. (64)

$$\begin{aligned}
 \text{CM size} &= 2^{\text{index}} \text{ cells} \\
 &= 2^{12} \text{ cells} \\
 &= 4 \text{ K cells} \\
 &= 4 \text{ KB} \\
 \text{MM size} &= 2^{\text{address}} \text{ cells} \\
 &= 2^{16} \text{ cells} \\
 &= 64 \text{ K cells} \\
 &= 64 \text{ KB}
 \end{aligned}$$

End of Solution

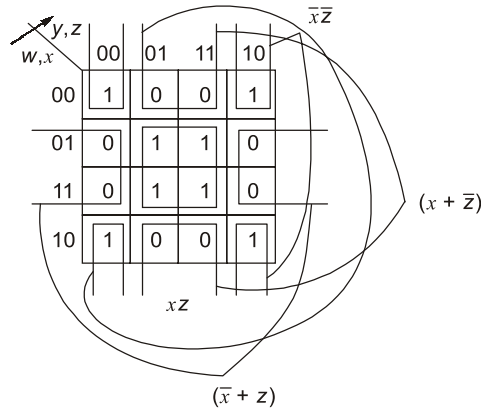
- Q.18** A Boolean function $f(w, x, y, z)$ is shown in the following K-map.

wx	yz				
		1	0	0	1
		0	1	1	0
		0	1	1	0
		1	0	0	1

Which of the following option is/are correct expression/expressions for Boolean function $f(w, x, y, z)$?

- (a) $xz + \bar{x}\bar{z}$
- (b) $\bar{x}z + x\bar{z} + x$
- (c) $(\bar{x}z)(x + \bar{z})$
- (d) $(x + \bar{z})(\bar{x} + z)$

Ans. (a, d)

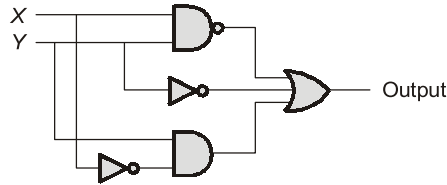


$$f(w, x, y, z) = xz + \bar{x}\bar{z}$$

$$f(w, x, y, z) = (x + \bar{z})(\bar{x} + z)$$

End of Solution

Q.19 The output expression of the given digital circuit is



(a) $x + y$

(b) $\bar{x} + y$

(c) $\bar{x}\bar{y}$

(d) $x + \bar{y}$

Ans. (c)

$$\begin{aligned} \text{Output} &= \bar{x}\bar{y} + \bar{y} + \bar{x}y \\ &= \bar{x} + \bar{y} + \bar{y} + \bar{x}y \\ &= \bar{x} + \bar{y} = \bar{x}\bar{y} \end{aligned}$$

End of Solution



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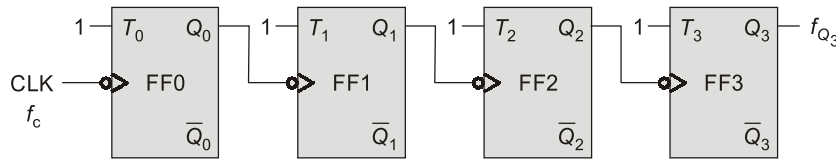
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Q.20 In a 4-bit ripple counter, time period of the wave form at last FF is $64 \mu\text{s}$. The clock frequency of ripple counter in kHz, _____

Ans. (250)



$$f_{Q_3} = \frac{f_c}{2^4} = \frac{f_c}{16}$$

$$\frac{1}{T_{Q_3}} = \frac{1}{T_c \times 16}$$

$$T_c = \frac{T_{Q_3}}{16} = \frac{64 \mu\text{s}}{16} = 4 \mu\text{s}$$

$$f_c = \frac{1}{4 \mu\text{s}}$$

$$f_c = \frac{1000}{4} \times 10^3 = 250 \text{ kHz}$$

End of Solution

Q.21 If matrix $A = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$ then A^8 is

(a) $\begin{bmatrix} 625 & 0 \\ 625 & 0 \end{bmatrix}$

(b) $\begin{bmatrix} 625 & 0 \\ 0 & 625 \end{bmatrix}$

(c) $\begin{bmatrix} 0 & 125 \\ 125 & 0 \end{bmatrix}$

(d) $\begin{bmatrix} 125 & 0 \\ 125 & 0 \end{bmatrix}$

Ans. (b)

$$A^2 = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix} = \begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix}$$

$$A^8 = [A^2]^4 = \begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix}^4$$

$$= \begin{bmatrix} 625 & 0 \\ 0 & 625 \end{bmatrix}$$

End of Solution

Q.22 If $\int_1^x t \ln t \, dt = \frac{1}{4}$; then the value of x is

- (a) e (b) \sqrt{e}
 (c) e^2 (d) $e - 1$

Ans. (b)

$$\int_1^x t \ln t \, dt = \frac{1}{4}$$

$$\ln t \cdot \frac{t^2}{2} - \int \frac{1}{t} \cdot t^2 = \frac{1}{4}$$

$$\left[\ln t \cdot \frac{t^2}{2} - \frac{t^2}{4} \right]_1^x = \frac{1}{4}$$

$$\left[\ln x \cdot \frac{x^2}{2} - \frac{x^4}{4} \right] + \frac{1}{4} = \frac{1}{4}$$

$$\ln x = \frac{1}{2}$$

$$x = e^{1/2} = \sqrt{e}$$

End of Solution

Q.23 LU - decomposition $P = LU$

- (a) If P is singular matrix, then only one of the diagonal element of L or U is 0
 (b) If P^{-1} exists then L and U both must be invertible.
 (c) If P^{-1} exists then L or U must be invertible.
 (d) None of these

Ans. (a, b)

(a)

$$|P| = 0$$

$$|LU| = 0$$

$$|L| = 0, |U| = 0$$

(b)

$$|P| = |LU| \neq 0$$

$$|L| \cdot |U| \neq 0$$

$$|L| \neq 0 \text{ and } |U| \neq 0$$

L^{-1} exists, U^{-1} exists

End of Solution

Q.24 $L^2 = L^{-1}$, $M = L^8$, $N = L^2$
 $|M - N| = ?$

Ans. (4)

$$\begin{aligned} |L^8 - L^2| &= |L^2 L^2 L^2 L^2 - L^2| \\ &= |L^2 L^2 L^{-1} L^{-1} - L^2| \\ &= |0| = 0 \end{aligned}$$

End of Solution

Q.25

Process	Arrival time	Burst time
P_1	0	10
P_2	1	13
P_3	2	6
P_4	8	9

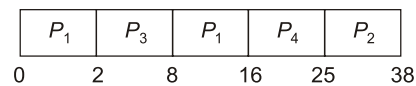
Using SRTF algorithm.

Find average turn around time _____?

Ans. (19)

Process	A.T.	B.T.	C.T.	T.A.T.
P_1	0	10	16	16
P_2	1	13	38	37
P_3	2	6	8	6
P_4	8	9	25	17

Gantt Chart:



$$\text{Average Turn Around Time} = \frac{16 + 37 + 6 + 17}{4} = \frac{76}{4} = 19$$

End of Solution

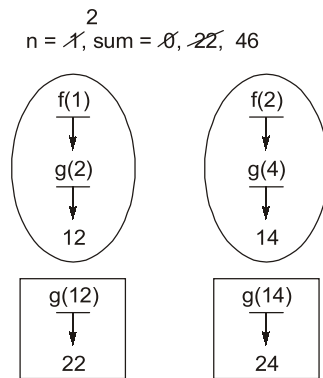
Q.26 Consider the following C program:

```
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 < 3; n ++ )
        sum += g(f(n));
    printf("%d", sum);
    return 0;
}
```

Ans. (46)



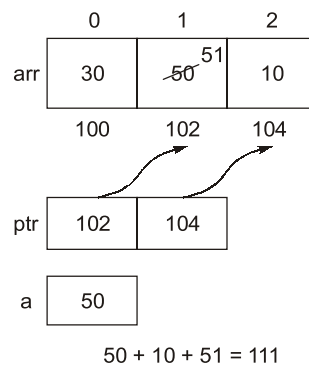
End of Solution

Q.27 Consider the following C program:

```

in a;
int arr[ ] = {30, 50, 10};
int *ptr = & arr[0] + 1;
a = *ptr;
(*ptr)++;
ptr = ptr + 1
printf("%d", a + *ptr + arr[1]);
    
```

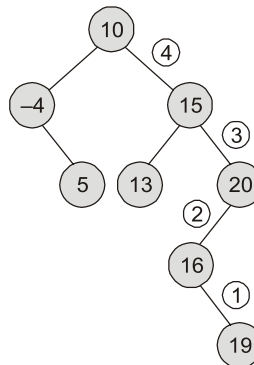
Ans. (111)



End of Solution

Q.28 In a BST with elements 10, -4, 15, 13, 20, 5, 16, 19 Find the number of edges from 19 to root node?

Ans. (4)



Number of edges from 19 to root node = 4.

End of Solution



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Q.30 Match the following:

List-I

1. CFL
2. Recursive language
3. Regular language

List-II

- (a) Closed under Union
- (b) Not closed under complement
- (c) Closed under intersection

Ans. 1 → (b), 2 → (a), (c), 3 → (a), (c)

1 → (b),

2 → (a), (c),

3 → (a), (c)

End of Solution

Q.31 Let G_1, G_2 are CFGs and R is a regular language then which of the following is decidable?

(a) Is $L(G_1) = \phi$?

(b) Is $L(R) = \phi$?

(c) Is $L(G_1) \cap L(G_2) = \phi$?

(d) Is $L(G_1) = L(G_2)$?

[MSQ]

Ans. (a, b)

(a) Emptiness of CFG is decidable.

(b) Emptiness of regular language is decidable

(c) Disjointness of CFLs is undecidable.

(d) Equivalence of CFLs is undecidable.

End of Solution

Q.32 Which of the following is accepted by DPDA?

(a) Regular

(b) CFL

(c) Decidable language

(d) Language accepted by NPDA

Ans. (a)

DPDA accepts DCFL and regular languages.

End of Solution

Q.33 Consider the following grammar:

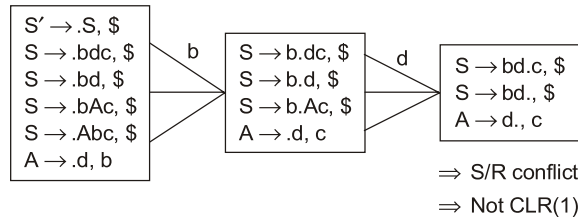
$S \rightarrow bdc \mid Abc \mid bd \mid bAc$

$A \rightarrow d$

Which of the following is true?

- (a) LALR
- (b) CLR
- (c) SLR
- (d) None of these

Ans. (d)



Not CLR(1) \Rightarrow Not LALR(1)
 \Rightarrow Not SLR(1)

Answer is option (d).

End of Solution

Q.34 F is set of $f^n : \{1 \text{ to } n\}$ to $\{0, 1\}$ such that every element in F, $\forall x, f(x) \leq g(x)$, then

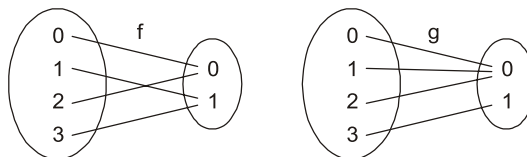
- (a) Let F is poset
- (b) Let F is lattice
- (c) Let F is equivalence
- (d) Let F is symmetric

[MSQ]

Ans. (a, b)

$$\forall x, f(x) \leq g(x)$$

Example: Let $n = 3$



$$f : \{(0, 0), (1, 1), (2, 0), (3, 1)\} \quad g : \{(0, 0), (1, 0), (2, 0), (3, 1)\}$$

$$f(x) \leq g(x) \Rightarrow R(\leq) = \{(0, 0), (0, 0), (1, 1)\}$$

We know that, ' \leq ' is a reflexive, antisymmetric and transitive

\therefore ' \leq ' is a poset.

We know that, if $R = \leq$, for every every number of elements there exists a lub and glb.

\therefore it is a lattice.

Hence it is a poset and lattice.

End of Solution



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