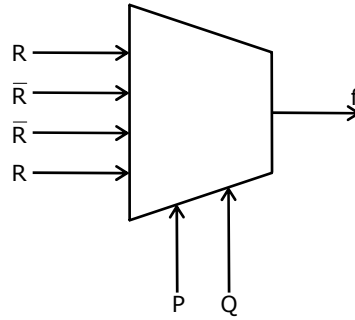


9. The Boolean expression for the output f of the multiplexer shown below is

- (A) $\overline{P \oplus Q \oplus R}$
- (B) $P \oplus Q \oplus R$
- (C) $P + Q + R$
- (D) $\overline{P + Q + R}$



10. In a binary tree with n nodes, every node has an odd number of descendants. Every node is considered to be its own descendant. What is the number of nodes in the tree that have exactly one child?

- (A) 0
- (B) 1
- (C) $(n-1)/2$
- (D) $n-1$

11. What does the following program print?

```
#include <stdio.h >
void f(int *p, int *g){
    p = g;
    *p = 2;
}
int i = 0, j = 1;
int main ( ){
    f(&i, & j);
    printf ("%d %d \n", i, j);
    return 0;
}
```

- (A) 2 2
- (B) 2 1
- (C) 0 1
- (D) 0 2

12. Two alternative packages A and B are available for processing a database having 10^k records. Package A requires $0.0001n^2$ time units and package B requires $10n \log_{10} n$ time units to process n records. What is the smallest value of k for which package B will be preferred over A?

- (A) 12
- (B) 10
- (C) 6
- (D) 5

13. Which data structure in a compiler is used for managing information about variables and their attributes?

- (A) Abstract syntax tree
- (B) Symbol table
- (C) Semantic stack
- (D) Parse table

14. Which languages necessarily need heap allocation in the runtime environment?
 (A) Those that support recursion (B) Those that use dynamic scoping
 (C) Those that allow dynamic data structures (D) Those that use global variables
15. One of the header fields in an IP datagram is the Time to Live (TTL) field. Which of the following statements best explains the need for this field?
 (A) It can be used to prioritize packets
 (B) It can be used to reduce delays
 (C) It can be used to optimize throughput
 (D) It can be used to prevent packet looping
16. Which one of the following is not a client server application?
 (A) Internet chat (B) Web browsing (C) E-mail (D) Ping
17. Let L1 be a recursive language. Let L2 and L3 be languages that are recursively enumerable but not recursive. Which of the following statements is not necessarily true?
 (A) $L2 - L1$ is recursively enumerable
 (B) $L1 - L3$ is recursively enumerable
 (C) $L2 \cap L1$ is recursively enumerable
 (D) $L2 \cup L1$ is recursively enumerable
18. Consider a B⁺-tree in which the maximum number of keys in a node is 5. What is the minimum number of keys in any non-root node?
 (A) 1 (B) 2 (C) 3 (D) 4
19. A relational schema for a train reservation database is given below
 Passenger (pid, pname, age)
 Reservation (pid, class, tid)

Table : Passenger

pid	'pname'	Age
0	'Sachin'	65
1	'Rahul'	66
2	'Sourav'	67
3	'Anil'	69

Table : Re reservation

pid	class	tid
0	'AC'	8200
1	'AC'	8201
2	'SC'	8201
5	'AC'	8203
1	'SC'	8204
3	'AC'	8202

23. Consider the methods used by processes P1 and P2 for accessing their critical sections whenever needed, as given below. The initial values of shared boolean variables S1 and S2 are randomly assigned.

Method used by P1	Method used by P2
while (S1 == S2) ; Critical Section S1 = S2;	while (S1 != S2) ; Critical Section S2 = not (S1);

Which one of the following statements describes the properties achieved?

- (A) Mutual exclusion but not progress
 (B) Progress but not mutual exclusion
 (C) Neither mutual exclusion nor progress
 (D) Both mutual exclusion and progress
24. A system uses FIFO policy for page replacement. It has 4 page frames with no pages loaded to begin with. The system first accesses 100 distinct pages in some order and then accesses the same 100 pages but now in the reverse order. How many page faults will occur?
 (A) 196 (B) 192 (C) 197 (D) 195
25. Which of the following statements are true?
 I. Shortest remaining time first scheduling may cause starvation
 II. Preemptive scheduling may cause starvation
 III. Round robin is better than FCFS in terms of response time
 (A) I only (B) I and III only (C) II and III only (D) I, II and III

Q. No. 26 – 51 Carry Two Marks Each

26. Consider a company that assembles computers. The probability of a faulty assembly of any computer is p . The company therefore subjects each computer to a testing process. This testing process gives the correct result for any computer with a probability of q . What is the probability of a computer being declared faulty?
 (A) $pq + (1-p)(1-q)$ (B) $(1-q)p$ (C) $(1-p)q$ (D) pq
27. What is the probability that divisor of 10^{99} is a multiple of 10^{96} ?
 (A) $1/625$ (B) $4/625$ (C) $12/625$ (D) $16/625$
28. The degree sequence of a simple graph is the sequence of the degrees of the nodes in the graph in decreasing order. Which of the following sequences can not be the degree sequence of any graph?
 I. 7, 6, 5, 4, 4, 3, 2, 1 II. 6, 6, 6, 6, 3, 3, 2, 2

III. 7, 6, 6, 4, 4, 3, 2, 2

IV. 8, 7, 7, 6, 4, 2, 1, 1

(A) I and II

(B) III and IV

(C) IV only

(D) II and IV

29. Consider the following matrix

$$A = \begin{bmatrix} 2 & 3 \\ x & y \end{bmatrix}$$

If the eigenvalues of A are 4 and 8, then

(A) $x = 4, y = 10$

(B) $x = 5, y = 8$

(C) $x = -3, y = 9$

(D) $x = -4, y = 10$

30. Suppose the predicate $F(x, y, t)$ is used to represent the statement that person x can fool person y at time t . which one of the statements below expresses best the meaning of the formula $\forall x \exists y \exists t (\neg F(x, y, t))$?

(A) Everyone can fool some person at some time

(B) No one can fool everyone all the time

(C) Everyone cannot fool some person all the time

(D) No one can fool some person at some time

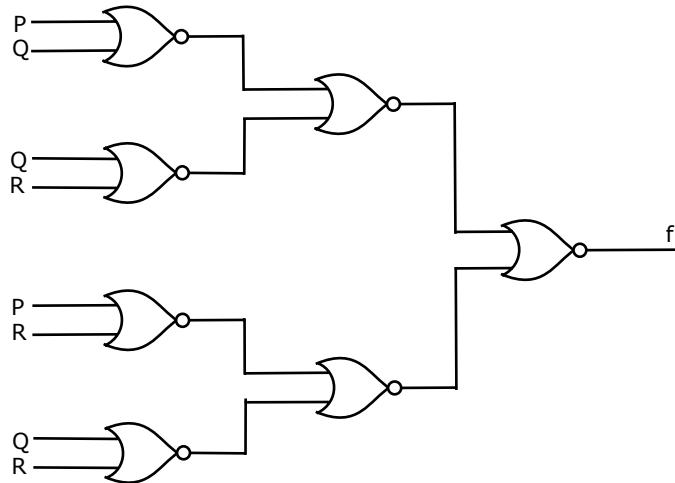
31. What is the Boolean expression for the output f of the combinational logic circuit of NOR gates given below?

(A) $\overline{Q + R}$

(B) $\overline{P + Q}$

(C) $\overline{P + R}$

(D) $\overline{P + Q + R}$



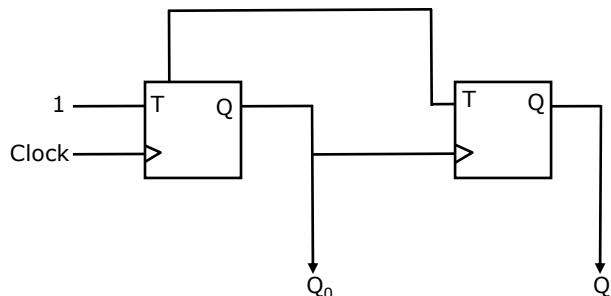
32. In the sequential circuit shown below, if the initial value of the output Q_1Q_0 is 00, what are the next four values of Q_1Q_0 ?

(A) 11,10,01,00

(B) 10,11,01,00

(C) 10,00,01,11

(D) 11,10,00,01



33. A 5-stage pipelined processor has Instruction Fetch (IF), Instruction Decode (ID), Operand Fetch (OF), Perform Operation (PO) and Write Operand (WO) stages. The IF, ID, OF and WO stages take 1 clock cycle each for any instruction. The PO stage takes 1 clock cycle for ADD and SUB instructions, 3 clock cycles for MUL instruction, and 6 clock cycles for DIV instruction respectively. Operand forwarding is used in the pipeline. What is the number of clock cycles needed to execute the following sequence of instructions?

<u>Instruction</u>	<u>Meaning of instruction</u>
$I_0 : \text{MUL } R_2, R_0, R_1$	$R_2 \leftarrow R_0 * R_1$
$I_1 : \text{DIV } R_5, R_3, R_4$	$R_5 \leftarrow R_3 / R_4$
$I_2 : \text{ADD } R_2, R_5, R_2$	$R_2 \leftarrow R_5 + R_2$
$I_3 : \text{SUB } R_5, R_2, R_6$	$R_5 \leftarrow R_2 - R_6$

- (A) 13 (B) 15 (C) 17 (D) 19
34. The weight of a sequence a_0, a_1, \dots, a_{n-1} of real numbers is defined as $a_0 + a_1 / 2 + \dots + a_{n-1} / 2^{n-1}$. A subsequence of a sequence is obtained by deleting some elements from the sequence, keeping the order of the remaining elements the same. Let X denote the maximum possible weight of a subsequence of a_0, a_1, \dots, a_{n-1} . Then X is equal to

- (A) $\max(Y, a_0 + Y)$ (B) $\max(Y, a_0 + Y/2)$ (C) $\max(Y, a_0 + 2Y)$ (D) $a_0 + Y/2$

35. What is the value printed by the following C program?

```
#include <stdio.h >
int f(int * a, int n)
{
    if (n <= 0) return 0;
    else if (*a % 2 == 0) return * a + f(a + 1, n - 1);
    else return * a - f(a + 1, n - 1);
}
int main ( )
{
    int a[ ] = {12, 7, 13, 4, 11, 6};
    printf("%d", f(a,6));
    return 0;
}
```

- (A) -9 (B) 5 (C) 15 (D) 19

36. The following C function takes a simply-linked list as input argument. It modifies the list by moving the last element to the front of the list and returns the modified list. Some part of the code is left blank.

```

typedef struct node {
    int value;
    struct node *next;
} Node;
Node *move_to_front(Node *head) {
    Node *p, *q;
    if ((head == NULL: || (head->next == NULL)) return head;
    q = NULL; p = head;
    while (p-> next !=NULL) {
        q=P;
        p=p->next;
    }
    _____
    return head;
}

```

Choose the correct alternative to replace the blank line.

- (A) q = NULL; p->next = head; head = p;
- (B) q->next = NULL; head = p; p->next = head;
- (C) head = p; p->next = q; q->next = NULL;
- (D) q->next = NULL; p->next = head; head = p;

37. The program below uses six temporary variables a, b, c, d, e, f.

```

a = 1
b = 10
c = 20
d = a + b
e = c + d
f = c + e
b = c + e
e = b + f
d = 5 + e
return d + f

```

Assuming that all operations take their operands from registers, what is the minimum number of registers needed to execute this program without spilling?

- (A) 2
- (B) 3
- (C) 4
- (D) 6

38. The grammar $S \rightarrow aSa|bS|c$ is

- (A) LL(1) but not LR(1)
- (B) LR(1) but not LR(1)
- (C) Both LL(1) and LR(1)
- (D) Neither LL(1) nor LR(1)

39. Let $L = \{w \in (0+1)^* \mid w \text{ has even number of 1s}\}$, i.e. L is the set of all bit strings with even number of 1s. Which one of the regular expressions below represents L ?

- (A) $(0^*10^*1)^*$ (B) $0^*(10^*10^*)^*$
 (C) $0^*(10^*1^*)^*0^*$ (D) $0^*1(10^*1)^*10^*$

40. Consider the languages $L_1 = \{0^i1^j \mid i \neq j\}$, $L_2 = \{0^i1^j \mid i = j\}$, $L_3 = \{0^i1^j \mid i = 2j+1\}$, $L_4 = \{0^i1^j \mid i \neq 2j\}$. Which one of the following statements is true?

- (A) Only L_2 is context free (B) Only L_2 and L_3 are context free
 (C) Only L_1 and L_2 are context free (D) All are context free

41. Let w be any string of length n in $\{0, 1\}^*$. Let L be the set of all substrings of w . What is the minimum number of states in a non-deterministic finite automaton that accepts L ?

- (A) $n-1$ (B) n (C) $n+1$ (D) 2^{n-1}

42. Consider the following schedule for transactions T_1 , T_2 and T_3 :

<u>T₁</u>	<u>T₂</u>	<u>T₃</u>
Read(X)		
	Read(Y)	
		Read(Y)
	Write(Y)	
Write(X)		
		Write(X)
	Read(X)	
	Write(X)	

Which one of the schedules below is the correct serialization of the above?

- (A) $T_1 \rightarrow T_3 \rightarrow T_2$ (B) $T_2 \rightarrow T_1 \rightarrow T_3$
 (C) $T_2 \rightarrow T_3 \rightarrow T_1$ (D) $T_3 \rightarrow T_1 \rightarrow T_2$

43. The following functional dependencies hold for relations $R(A, B, C)$ and $S(B, D, E)$

$B \rightarrow A$,
 $A \rightarrow C$

The relation R contains 200tuples and the relation S contains 100tuples. What is the maximum number of tuples possible in the natural join $R \bowtie S$?

- (A) 100 (B) 200 (C) 300 (D) 2000

