Branch : CSE/IT **Batch : Hinglish**

WEEKLY TEST – 01
Subject : Algorithm
Topic : Analysis of Algorithm

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. sort the functions in increasing order of asymptotic (big – O) complexity

$f_1(n) = n^{0.999999} \log n$

$f_2(n) = 10000000n$

$f_3(n) = 1.000001^n$

$f_4(n) = n^2$

(a) $f_1(n), f_2(n), f_4(n), f_3(n)$
(b) $f_3(n), f_4(n), f_2(n), f_1(n)$
(c) $f_2(n), f_4(n), f_1(n), f_3(n)$
(d) None of these

[MCQ]

2. Sort the function in decreasing order of asymptotic (big – O) complexity: -

$f_1(n) = 2^{2^{1000000}}$

$f_2(n) = 2^{100000^n}$

$f_3(n) = n\sqrt{n}$

(a) $f_2(n), f_1(n), f_3(n)$ (b) $f_3(n), f_1(n), f_2(n)$
(c) $f_1(n), f_3(n), f_2(n)$ (d) None of these

[MCQ]

3. We know that O(g(n))

$$= \begin{cases} f(n): \text{There exist positive constant c and } n_0 \\ \text{Such that } 0 \le f(n) \le c.g(n), \text{for all } n \ge n_0 \end{cases}$$

Given that $f(n) = 10n^2 + 100$ and $g(n) = 2^n$;
where n and no are both positive integers.
if c = 0.125 then for which value of n_0,
f(n) = O(g(n))?

(a) 12 (b) 13
(c) 14 (d) 15

[MCQ]

4. Suppose that there are 3 programs X_1, X_2 and X_3 having time complexities $f_1(n)$, $f_2(n)$ and $f_3(n)$ respectively. Such that $f_1(n)$ is $O(f_2(n))$, $f_2(n)$ is $O(f_1(n))$, $f_1(n)$ is $O(f_3(n))$ and $f_3(n)$ is not $O(f_1(n))$. Then which one of the statements is true from the following statements?

(a) X_3 is always faster than X_1 and X_2 for very large size inputs
(b) X_1 is faster than X_2 and X_3 for very large inputs
(c) X_3 is slower than X_1 and X_2 for very large input
(d) X_2 is faster than X_1 and X_3 for very large size inputs

[MCQ]

5. Let $f(n) = \log\log\log\sqrt{n}$ and $g(n) = 2^{30^{30^{30}}}$ then which one of the following is true?

(i) $f(n) = \theta(g(n))$
(ii) $f(n) = \Omega(g(n))$
(iii) $f(n) = O(g(n))$
(iv) $f(n) = \omega(g(n))$

(a) (i), (ii) and (iii) only
(b) (ii), (iii) and (iv) only
(c) (ii) and (iv) only
(d) (iv) only

Q.5 to 10 Carry TWO Mark Each

[MCQ]

6. Consider the following code.

```
int a = 0;
for(int x = 0; x < n; x ++) {
        if (x%5==0){
                for (int y = 0; y < n; y ++){
                        if (x  = = y)
                                a+ = x * y )
                        }
        }
}
```

What is the highest asymptotic worst case time complexity of above code fragment?

(a) $O(n^2)$ (b) $O(\sqrt{n})$

(c) O(n) (d) O(log n)

[MCQ]

7. Arrange following function in the ascending order growth rate.

$f_1 = (1 + 0.0001)^n$, $f_2 = \sqrt{n}^{\log n}$, $f_3 = (1.005)^{\sqrt{n}}$

$f_4 = (\log n)^{\sqrt{n}}$, $f_5 = (\sqrt{n})^{\log n^2}$

(a) f_2, f_5, f_3, f_4, f_1 (b) f_3, f_4, f_2, f_5, f_1

(c) f_2, f_5, f_1, f_3, f_4 (d) None of the above

[MCQ]

8. What is the time complexity of the following code ?

```
for (a = 0; a < n – 2; a ++)
{
        for (b = 0; b < 100 ; b = b + 2)
            {
                for (c = 1; c < 8∗n; c ++)
                  {
                                ----------
                                ----------
                                ----------
                        }
                }
        }
```

(a) $O(n^3)$ (b) $O(n^2)$

(c) O(logn) (d) O(n)

[NAT]

9. How many of the following statements is/are false____.

(i) $10\sqrt{n} + \log n = O(n)$

(ii) $\sqrt{n} + \log n = O(\log n)$

(iii) $\sqrt{n} + \log n = \theta(n)$

(iv) $\sqrt{n} + \log n = \theta(\sqrt{n})$

[MCQ]

10. Consider the following recursion function

```
P(n)
{
        if (n < = 0)
        return 1;
else if (n% 2 = = 0)
return P(n – 1);
else
return P(n–2);
}
```

What is the time complexity of above code?

(a) θ(logn) (b) $\theta(2^n)$

(c) θ(n) (d) none of these

Answer Key

1.	**(a)**	**6.**	**(a)**
2.	**(d)**	**7.**	**(a)**
3.	**(d)**	**8.**	**(b)**
4.	**(c)**	**9.**	**(2)**
5.	**(c)**	**10.**	**(c)**

Hints and Solutions

1. (a)

The correct order of these functions is

$f_1(n)$, $f_2(n)$, $f_4(n)$, $f_3(n)$. To see why, $f_1(n)$ grows asymptotically slower than $f_2(n)$, recall that for any $c > 0$, $\log n$ is $O(n^c)$. Therefore, we have

$f_1(n) = n^{0.999999} \log n = 0(n^{0.999999}.n^{0.000001}) = O(n) = O(f_2(n))$

The function $f_2(n)$ is linear, while function $f_4(n)$ is quadratic, So $f_2(n)$ is $O(f_4(n))$. Finally, we know that $f_3(n)$ is exponential, which grows faster than quadratic, So, $f_4(n)$ is $O(f_3(n))$.

2. (d)

The correct order of these functions is $f_2(n)$, $f_3(n)$, $f_1(n)$ in decreasing order. The variable n never appears in the formula $f_1(n)$. So despite the multiple exponentials, $f_1(n)$ is constant. Hence it is asymptotically smaller than $f_3(n)$ which does grow with 'n'.

$f_2(n) = 2^{100000n}$ $\qquad f_3(n) = n\sqrt{n}$

n = 1 $\qquad 2^{100000\times 1} > 1\sqrt{1}$

n = 2 $\quad 2^{100000\times 2} > 2\sqrt{2}$

$\vdots$

$\therefore f_2(n) > f_3(n)$

Option (a), (b), (c) are not correct option.

So, $f_2(n)$ $f_3(n)$ $f_1(n)$ is correct decreasing order.

Hence option (d) is correct.

3. (d)

Given C = 0.125

$f(n) \leq C.g(n)$

$10n^2 + 100 \leq 0.125 \times 2^n$

We need to check from n = 1 to 15

So, if n = 15

$10 * (15)^2 + 100 \leq 0.125 \times 2^{15}$

$2250 + 100 \leq 0.125 \times 32768$

$2350 \leq 4096$ (True)

4. (c)

Given, $\quad f_1(n) = O(f_2(n))$

$f_2(n) = O(f_1(n))$

$f_1(n) = O(f_3(n))$

$f_3(n) \neq O(f_1(n))$

The above functions conclude that, growth of f3 is larger than the growth rate of f_1 and f_2.

$\therefore$ $\quad x_3$ is slower than x_1 or x_2.

5. (c)

$f(n) = \log\log\log\sqrt{n}$, $g(n) = 2^{20^{20^{20}}}$

$f(n) = \Omega(g(n)$ because g(n) is constant and

f(n) is depending on 2 ,therefore it is correct.

$f(n) \neq O(g(n))$ because f(n) is greater than g(n)

$f(n) = w(g(n))$ because $f(n) > g(n)$,Correct.

$\therefore$ $\quad$ (ii) and (iv) are true.

6. (a)

The inner most loop (if statement) executes per loop, we must check x = = y is true one per each iteration. This will take some non-zero constant amount of time. So the innermost loop will perform approximately n work.

The outer most loop and if statement will perform 'n' work during only $1/5^{th}$ of the iteration and will perform a constant amount of wort in the remaining $4/5^{th}$ of the time.

So, total amount of work done is approximately $\frac{n}{5}\cdot n + \frac{4n}{5}\cdot 1$

$\therefore T(n) = \frac{n^2}{5} + \frac{4n}{5}$

Which is $O(n^2)$

7. (a)

As we can see f_1 and f_3 are similar so lets compare these first.

$f_1 = (1 + 0.0001)^n$

$f_3 = (1.005)^{\sqrt{n}}$

$\therefore$ By seeing n and $\sqrt{n}$ in exponents we can conclude that $f_1 > f_3$ ….. (a)

Now comparing f_2, f_4, and f_5

$f_2 = \left(\sqrt{n}\right)^{\log n}$, taking log

$\log n \log \sqrt{n}$

$f_4 = (\log n)^{\sqrt{n}}$, taking log

$\sqrt{n} \log(\log n)$

$f_5 = \left(\sqrt{n}\right)^{\log n^2}$, taking log

$\log n^2 \log\left(\sqrt{n}\right)$

Form above we can clearly see that

$f_5 > f_2$ and $f_4 > f_5$ because of $\sqrt{n} > \log n$ ……. (b)

Now comparing f_1 and f_2

$(1 + 0.0001)^n = \left(\sqrt{n}\right)^{\log n}$

Taking log on both sides we get

$n \log 1.001 = \log n \log \sqrt{n}$

By comparing above we can clearly say that ‘n’ of f_1 will always be greater and n makes greater than f_2.

$\therefore f_1 > f_2$ …..(c)

and similarly $f_5 > f_1$ …..(d)

also, $f_1 > f_4$ solving by using log….(e)

$\therefore$ from (a), (b), (c), (d) and (e)

We can conclude that

$f_1 > f_4 > f_3 > f_5 > f_2$

$\therefore f_2\ f_5\ f_3\ f_4\ f_1$ is correct answer.

8. (b)

- a ranging from 0 t n – 2 in first loop so it is O(n)
- b is ranging from 0 to 100 which is constant time in 2^{nd} (inner loop) so O(1)
- C is ranging from 1 to 8 n inner loop so it is O (n)

  n * 1 * n which is n^2

$\therefore O(n^2)$, so option (b) is correct.

9. (2)

(i) $10\sqrt{n} + \log n = O(n)$ Correct, because

$\therefore \sqrt{n} < n$

(ii) $\sqrt{n} + \log n = O(\log n)$ incorrect because

$\sqrt{n} > \log n$

(iii) $\sqrt{n} + \log n = \theta(n)$ incorrect it should be O(n) or θ(log)

(iv) $\sqrt{n} + \log n = \theta\sqrt{n}$, Correct

10. (c)

One of P(n – 1) of P(n – 2) will be called ,

In worst case

$T(n) = T(n - 1) + O(1)$

$T(n) = \theta(n)$

Branch : CSE/IT **Batch : Hinglish**

WEEKLY TEST – 02

Subject : Algorithms

Topic : Design Strategies

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. What is the tightest Big -O time complexity for the following code?

```
int fun(int n)
    {
            if (n < = 0)
             {
              return 0;
             }
        else if (n> = 2000)
             {
              return 1;
             }
        int count = 0
        for (int a = 0; a <n; a++)
            {
            count ++;
            }
        fun (n/2);
        fun(n/2);
        return count;
    }
```

(a) O(1) (b) O(n)
(c) O(n^2) (d) O(nlogn)

[MCQ]

2. What is the time complexity of an efficient algorithm to determine if an integer array x contains two consecutive integers?

(a) O(n) if x is sorted, (or) O(nlogn) otherwise
(b) O(nlogn) whether x is sorted or not sorted
(c) O(n) if x is sorted (or) O(n^2) otherwise
(d) O(n^2) whether or not x is sorted.

[MSQ]

3. Consider the following statements

(a) Inserting, Deleting in arrays takes O(N) time, containing N elements.
(b) Inserting, deleting in string takes O(N) time.
(c) Space complexity for each operation in a linked list is O(1)
(d) The worst-case time complexity of binary search tree is O(n).

[MCQ]

4. What will be the worst case time complexity for the following code?

```
int foo(int a[ ], int x)
 {
      int result = 0;
      for (int p = 0; p < x; p++){
         for (int q = 0; q < 7; q++){
            for (int r = 0; r < x; r++){
              {
                 result + = q * q + a[r];
              }
         }
  }
 return result;
 }
```

(a) O(n) (b) O(n^2)
(c) O(nlogn) (d) None of the above

[MCQ]

5. Consider an stack of having ‘n’ elements, inorder to reverse the elements in stack first pop off the elements one by one from stack and enqueue them into a queue. Then deque the elements one by one from the queue and push them back onto the stack, then what is the time complexity of above operation?

(a) O(n) (b) O(n^2)
(c) O(nlogn) (d) O(logn)

Q.6 to 10 Carry TWO Mark Each

[MCQ]

6. A = {a_1, a_2 …… a_n} is an array consisting of 'n' distinct integers and 'a' is an integer, design an efficient algorithm to determine whether there are two elements in 'A' whose sum is exactly 'a'. Find the time complexity of the algorithm which was designed.

(a) O(nlogn) (b) O(n^2)
(c) O(n) (d) none of these

[MCQ]

7. Consider the following function foo()____?

```
void foo(int x)
     {
         int a, b, c, d;
         for (a = 0; a < 1000; a++)
           {
             for (b = 0 b< n; b++)
                 {
                     for (c = 0; c < b; c++)
                         printf("%d",c)
                 }
           }
     }
```

What is the worst case running time of the function foo() for any positive value of x?

(a) O(n) (b) O(n^2)
(c) O(n^3) (d) O(1)

[MCQ]

8. What is the running time of the following c-program. Assume that n ≥ 1 and time complexity as a function of n.

```
a = n;
while (a > 0)
     {
        b = n;
        while (b > 0)
          {
            Add = Add + 10;
               b = b/2
          }
     a = a – 10;
     }
```

(a) O(n^2) (b) O(n)
(c) O($n\log_2 n$) (d) O(n^2logn)

[MCQ]

9. Consider the following Snippet of code.

```
 Addn = 0;
for (a = 1 to n)
     for (b = a to 2n)
          Addn = Addn + 1;
```

What is the time complexity of above given code?

(a) O(nlogn) (b) O(n)
(c) O(n^2) (d) O(n^2logn)

[MCQ]

10. Consider T(n + 1) = T(n) + 4n and T(n) = 1 then what is the value of T(n) in terms of n?

(a) $n^2 - n + 1$ (b) $2n^2 - 2n + 1$
(c) $2n^2 - 2n + 1$ (d) None of the above

Answer Key

1. **(a)**
2. **(a)**
3. **(a, b, c, d)**
4. **(b)**
5. **(a)**
6. **(a)**
7. **(b)**
8. **(c)**
9. **(c)**
10. **(b)**

Hints and Solutions

1. (a)

When n < = 0 which will return 0.

$\therefore$ O(1)

When n > = 2000, returns 1

$\therefore$ O(1)

When O < n < 2000, Here loop will run for a constnat time. Hence time complexity for large value of n is O(1) and the complexity of above code is O(1)

$\therefore$ option (a) is correct.

2. (a)

In order to check consecutive integer in a sorted array x, check

```
for (a = 0; a ≤ n; a++){
        if(x[a] = = x[a + 1] – 1)
            {
                print("exixts");
                Break
            }
}
```

This can be done in O(n) for sorted array.

for uinserted array, firstly sort the array in O(nlogn) time and then apply above algorithm.

$\therefore$ correct option is (a).

3. (a, b, c, d)

(a) yes, Inserting, Deleting in arrays takes O(N) time. Containing N elements

(b) yes, Inserting, deleting in string takes O(N) time, containing N-elements.

(c) yes, Space complexity for each operation in a linked list O(1)

(d) yes, The worst case time complexity of binary search tree is O(n).

4. (b)

p runs for n times(x)
q runs for 7 times
r runs for n times (x)
$\therefore 7n^2 \Rightarrow O(n^2)$

5. (a)

Popping off all elements from stack and enqueuing them into queue will take O(n) time. Similarly enqueuing all n elements from queue and push them onto stack, again it will take O(n)

Total time = O(n + n)

= O(2n)

= O(n)

6. (a)

Firstyly sort the given array 'A' in O(nlogn) time, after sorting take two pointers and start them from the left and right extreme of the sorted array 'A' and move them inwords. i.e… the left pointer moving right and the right pointer morining left. Check the sum of two number pointed by these pointers. If the sum is equal to x, then stop and return it otherwise continue above process till the pointers meet. This process takes time complexithy of O(n)., So the total time taken is O(nlogn).

$\therefore$ option (a) is correct.

7. (b)

$$foo(n)\sum_{a=0}^{999}\sum_{b=0}^{n-1}\left(\sum_{c=0}^{b-1}1\right)=O(n^2)$$

8. (c)

As we can see that, inner loop will be executing $\log_2 n$ time for every a.

$$b=n,\frac{n}{2},\frac{n}{4}......\frac{n}{n} \Rightarrow \log_2 n \text{ series}$$

outerloop: a = n, n – 10, n – 20 ….. 1

$$\therefore\ O\left[\frac{n}{10}\right]=O(n)$$

$\therefore$ Time complexity (T.C) = $O(\log_2 n)$

Hence option (c) is correct.

9. (c)

$$\sum_{a=1}^{n}\sum_{b=1}^{2n}(1)=\sum_{a=1}^{n}\left(1+1+1+1+....(2n-a+1)\,\text{times}\right)$$

$$= \sum_{a=1}^{n}(2n-a+1)=2n\sum_{a=1}^{n}(1)-\sum_{a=1}^{n}a+\sum_{a=1}^{n}(1)$$

$$= 2n(n)-\frac{n(n+1)}{2}+n$$

$= O(n^2)$

∴ option (c) is correct.

10. (b)

Given

$T(n + 1) = T(n) + 4(n)$

$T(n) = T(n - 1) + 4 (n - 1)$

$T(n) = T(n - 2) + 4 (n - 2) + 4 (n - 1)$

$T(n) = T(n - 3) + 4 (n - 3) + 4 (n - 2) + 4(n - 1)$

$= T(n - k) + 4(n - k) + 4 (n - k + 1) + \ldots\ldots$

$4 (n - 3) + 4 (n - 2) + 4 (n - 1)$

let $n - k = 1 \Rightarrow k = n - 1$

$T(n) = T(1) + 4 (1) + 4(2) + 4(3) + \ldots.. 4 (n - 2) + 4 (n - 1)$

$= 1 + 4 \{1 + 2 + 3 + \ldots\ldots n - 1\}$

$= 1 + \dfrac{4n(n-1)}{2} \Rightarrow 1 + 2n(n - 1)$

$= 2n^2 - 2n + 1$

∴ option (b) is correct.

Branch : CSE/IT **Batch : Hinglish**

WEEKLY TEST – 03
Subject : Algorithm
Topic : Design Strategy

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. Assume that there are 4n sorted list of size $\left(\frac{n}{2}\right)$, then what is the time complexity of merging them into single sorted list

(a) $\theta(n^2 \log n)$ (b) $(\log n)$
(c) $\theta(n\log n)$ (d) $\theta(n^2)$

[MSQ]

2. Assume that, quick sort implementation is used to sort an array in ascending order after the first partition step has been completed, the contents of the array are in the following order.
50 30 40 20 80 90 120 100 140 110 160
Which of the following elements could be a pivot element?

(a) 40 (b) 30
(c) 80 (d) 160

[NAT]

3. Assume that a binary search is used to search for a particular key within a sorted array of 256 values then what is the maximum number of key comparisons, the program. Would require to make before finding the key ______________(if the key is present ,round of to two decimal.)

[MSQ]

4. Choose the correct statements from the following statements

(a) Binary search in an unsorted array will take O(nlogn) time in worst case.
(b) Searching for an element in an unsorted array will take O(n) time in the worst case.
(c) Binary search on a sorted linked list takes O(n) time in worst case.
(d) Applying binary search on sorted linked list takes O(logn) time in worst case.

[MCQ]

5. What is the auxiliary space complexity of merge sort

(a) O(1) (b) O(logn)
(c) O(n) (d) O(nlog)

Q.6 to 10 Carry TWO Mark Each

[NAT]

6. Generally, merge is a divide and conquer technique which can also be implemented in a recursive manner. If there are 200 elements in an array then find the exact number of merge sort function calls which will perform the recursive call______.

[MSQ]

7. Consider the following code segment
(Note: n is power of 2 and base of log is 2)

```
int a, b, n;
for (a = 2; a < 2^logn; a++)
    {
        for (b = 2; b< = a; b++)
          {
          if(b%i = = 0)
          printf ("GATEWALLAH");
          }
    }
```

Which of the following statements is/are true?

(a) If f(n) is the number of times "GATEWALLAH" printed in terms of n, then f(n) is equivalent to n
(b) If f(n) is the number of times "GATEWALLA" is printed in terms of n then f(n) is equivalent to n – 1
(c) Time complexity of the given code is $\theta(n)$
(d) Time complexity of the given code is $\theta(n^2)$

[MCQ]

8. Consider a variation of merge sort in which we divide the list into 3 sorted sub lists of equal size, recursively sorting each list, and then merging the three lists to get the final sorted list.

What is the recurrence relation that is required for the number of comparisons used by this algorithm in worst case?

(NOTE: Assume that the number of elements to be sorted is a power of 3 so that all of the divisions are into three sub lists workout evenly)

(a) $T(n) = 3T(n/3) + n - 1$
(b) $T(n) = 2T(n/2) + n - 1$
(c) $T(n) = 6T(n/3) + n - 1$
(d) None of these

[MCQ]

9. Consider a list which contains 2^n sorted lists each of size n and is merged using merge sort, then what is the tightest upper bound worst case complexity?

(a) $O(n^2 2^n)$
(b) $O(2^n \log n)$
(c) $O(n.2^n)$
(d) None of these

[MCQ]

10. Let's suppose you are given an array in which, the few elements in the beginning are present in ascending order and remaining elements are in descending order, then what is the complexity of most efficient algorithm to find the maximum value of this array?

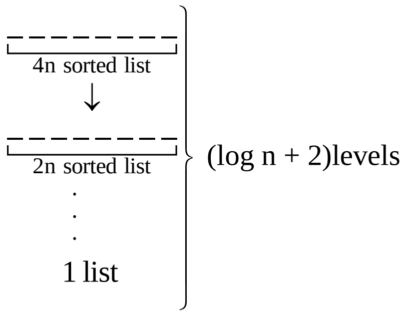
(a) $\theta(n \log n)$
(b) $\theta(n)$
(c) $O(1)$
(d) $\theta(\log n)$

Answer Key

1. **(a)**
2. **(c, d)**
3. **(8 to 8)**
4. **(a, b, c)**
5. **(c)**
6. **(398 to 398)**
7. **(b, d)**
8. **(a)**
9. **(a)**
10. **(d)**

Hints and Solutions

1. (a)



Merging time complexity at each level = $4n \times \frac{n}{2} = 2n$

$\therefore$ $2n^2$ (logn + 2) = θ (n^2 logn)

2. (c, d)

All the elements before 80 are less than 80 and elements after 80 are greater than so 80 could be a pivot element.

All elements before 160 are less than 160, s0 160 could also be a pivot element.

$\therefore$ option (c, d) are correct.

3. (8 to 8)

The maximum number of comparisons in a binary search on sorted array of 256 elements are $\lceil \log_2 n \rceil$, where n is the number of elements.

$\therefore$ $\lceil \log_2{}^{256} \rceil$, = 8

$\therefore$ 8 number of comparisons are required (This include the case where elements not present in the array)

4. (a, b, c)

(a) Yes, Binary search in an unsorted array will take O(nlogn) time in worst case.

(b) Yes, Searching an elements in an unsorted array will take O(n) time in the worst case.

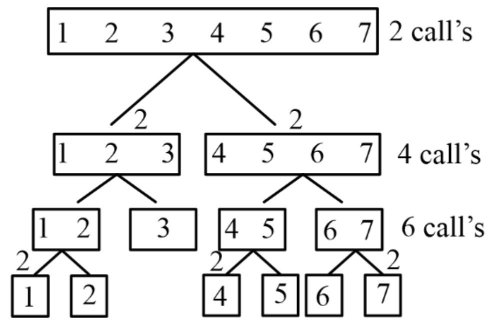
(c) Yes, Binary search on an sorted linked list takes O(n) time in worst case.

5. (c)

An additional space of O(n) is required in order to merge two sorted arrays. Thus, merge sort is not an in-place sorting algorithm.

6. (398 to 398)

n=7



For $n = 1 \rightarrow 0$ calls

$n = 2 \rightarrow 2$ calls

$n = 3 \rightarrow 4$ calls

$n = 4 \rightarrow 6$ calls

$\therefore$ generalized formula is 2(n–1) calls

So, for n = 200,

2(200 – 1) = 2 (199) = 398

7. (b, d)

As we can see that,

Whenever "b = i" in inner loop, "GATEWALLAH" will be printed, so "GATEWALLAH" will be printed energy time once for i = 2 to i = n ie,.. (n – 1) times

f(n) = (n – 1)

Also, for (i = 2) inner loop will execute for 2 times

for (i = 3) inner loop will execute for 3 times.

for (i = n) inner loop will execute for n times.

So, total complexity of given code is

$$2 + 3 + 4 \ldots\ldots n \Rightarrow \frac{n(n+1)}{2} - 1 = \theta(n^2)$$

$\therefore$ option b, d are correct.

8. (a)

let $T(n)$ be the time of sorting the list using merge sort.

Given that list has to be divided into 3 equal parts and perform sorting in each sub lists

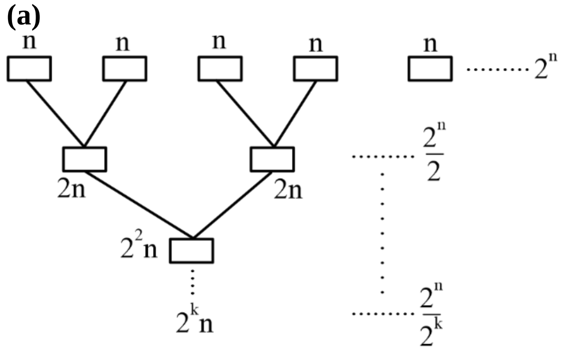
So, $T(n) = T(n/3) + T(n/3) + T(n/3)$

After performing sorting, we need to copy the list again into the original list which will take $(n - 1)$ units or work.

$T(n) = 3T(n/3) + n - 1$

$\therefore$ option (a) is correct.

9. (a)



Cost of level 0 $2^n \times n$

Cost of level 1 is $\frac{2^n}{2} \times 2n = 2^n \times n$

$\therefore$ cost of every level is $2^n \times n$

Total number of levels $= k + 1$ $\{2^0$ to $2^k\}$

Overall cost $= 2^n \times n\,[k + 1]$

Here $\frac{2^n}{2^k} = 1$

$2^k = 2^n$

Taking log on both sides

$k = n$

$\therefore$ overall cost $= 2^n \times n\,(n + 1)$

$= 2^n \times n^2 + 2^n \times n = O(n^2 \times 2^n)$

$\therefore$ (a) is correct option.

10. (d)

Apply binary search

If a[mid] > a [right & a[mid] > a[left]

Then max = a[mid]

if a[mid] > a [right] & a [mid] < a [left] $\rightarrow$ binary search (start, mid -1)

if a[mid] <a[right] & a[mid] > a[left] $\rightarrow$ binary search (mid+1, last)

Branch : CSE/IT **Batch : Hinglish**

WEEKLY TEST – 04

Subject : Algorithms

Topic : Greedy Method

Maximum Marks 15

Q.1 to 4 Carry ONE Mark Each

[MCQ]

1. Consider the statements

S1: Dijkstra's algorithm for single source shortest path is guaranteed to work if there are no negative cycles.

S2: Prim's algorithm for MST is guaranteed to produce MST even if there is negative weight cycles.

(a) only S1 is true
(b) only S2 is true
(c) Both S1 and S2 are true
(d) Neither S1 nor S2 is true

[MCQ]

2. What is the time complexity of the merge sort algorithm if the array contains more than half of repeated elements?

(a) O(nlogn) (b) O(n)
(c) $O(n^{2)}$ (d) None of these

[MCQ]

3. What is the time complexity of Dijkstra's algorithm in case of a sparse directed connected graph represented as an adjacency matrix.

(a) O(vlogv) (b) O(Elogv)
(c) $O(v^2)$ (d) None of these

[MCQ]

4. What is the time complexity of the job sequencing with deadline algorithm if greedy method is used?

(a) $O(n^2)$ (b) O(nlogn)
(c) O(n) (d) $O(n^2 \log n)$

Q.5 to 8 Carry TWO Mark Each

[MCQ]

5. The profit of the optimal schedule with the following jobs and deadlines given below.

Job	1	2	3	4	5	6
Deadline	5	4	4	2	1	2
Profit	15	12	5	15	13	14

What is the total profit?

(a) 58 (b) 59
(c) 60 (d) 61

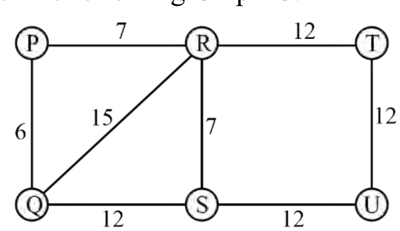
[MCQ]

6. Consider P, Q, R, S which is used to make a text each occurring with the probability of 0.38, 0.25, 0.08, 0.15, 0.14 respectively. Then optimal coding technicians will have the average length of _______.

(a) 2.21 (b) 2.9
(c) 1.58 (d) 1.69

[NAT]

7. Consider the following Graph G.



What is the total number of minimum spanning trees possible using prim's (or) Kruskal's algorithm? ______

[MCQ]

8. Consider a modified version of Quick sort where we have an input as an sorted array X[1 ……. n], all element of the array is distinct and $n \geq 3$. Pivot is median of set of 3 elements (first, middle, last). Then what is the worst-case time complexity of this algorithm?

(a) $O(n^2)$
(b) O(nlogn)
(c) $O(n^2 \log n)$
(d) O(nlog logn)

9. **[NAT]**

Consider the following array with 90 as the first element, all other elements can be in any order.

90, 116, 20, 76, 104, 176, 36

quick sort partition algorithm is used by choosing 1st elements as pivot, then what is the total number of arrangements of integer is possible to preserve the effect of first pass of partition algorithm?

10. **[NAT]**

Consider an array X of length n array contains number between (1 – 10) in any arbitrary order, best sorting algorithm takes 325 ns if n = 25, the time required by algorithm if n = 150 is ______?

Answer Key

1. **(b)**
2. **(a)**
3. **(c)**
4. **(a)**
5. **(d)**
6. **(a)**
7. **(3 to 3)**
8. **(b)**
9. **(36 to 36)**
10. **(1950 to 1950)**

Hints and Solutions

1. (b)

S1(False): if there exist any negative weight edges, then it may or may not work as expected.
S2(True): It is guaranteed to produce the MST even there exists negative weight cycles.

2. (a)

Irrespective of the elements the time complexity of merge sort is always O(nlogn)

3. (c)

If the graph is input by adjacency matrix then the T.C is $O(v^2)$ as for each vertex we need to check if it is connected to all other neighboring vertices.

$\therefore$ option (c) is correct.

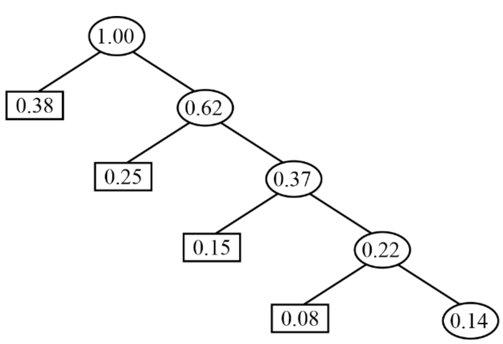
4. (a)

for Job sequencing algorithm, time required to sort in order get maximum profit is O(nlogn) find the max deadline = O(n)
For each slot 'i' apply linear search to find a job containing deadline $\geq i = O(n^2)$
$T(n) = O(n\log n) + O(n) + O(n^2) = O(n^2)$

5. (d)

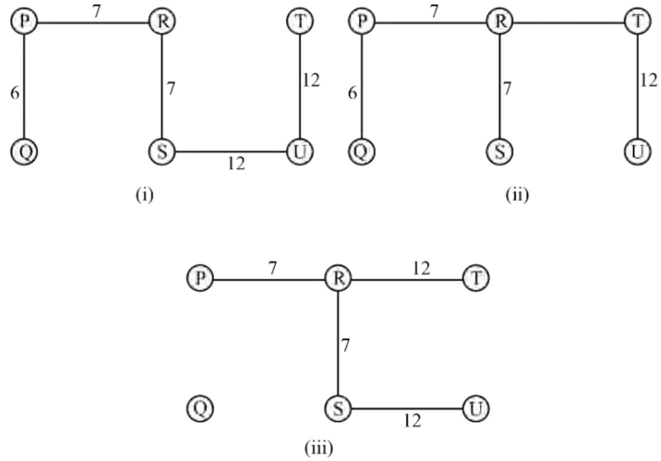
Time	1	2	3	4	5	
Job	J6	J4	J3	J2	J1	Total profit
Profit	14	15	5	12	15	61

6. (a)



Average length = 0.38 × 1 + 0.25 × 2 + 0.15 × 3 + 0.08 × 4 + 0.14 × 4
= 0.38 + 0.5 + 0.45 + 0.32 + 0.56 = 2.21

7. (3 to 3)



8. (b)

As we can see that array is sorted, finding first, middle and last will take O(1) time and the selected pivot will divide the given array in two pards of n/2.

$$T(n) = 2T\left(\frac{n}{2}\right) + O(n)$$

= O (nlogn)

9. (36 to 36)

First element is chosen as pivot and 90 is first elements, after 1St pass pivot goes to correct place.
So, all elements less than 90 go to left of it and greater will go to right of pivot.

20 36 76 90 116 104 176

3! 3!

6 × 6 = 36

10. (1950 to 1950)

We known the range of the elements present in the array X, so we can use counting sort, which takes O(n) time

C.n = 325
C.25 = 325
C = 13
n = 150
150 × 13 = 1950

❑❑❑

Branch : CSE/IT **Batch : Hinglish**

WEEKLY TEST – 05
Subject : Algorithms
Topic : Dynamic Programming

Maximum Marks 12

Q.1 to 4 Carry ONE Mark Each

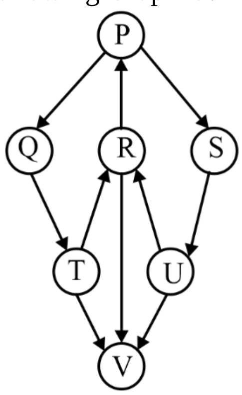
[MCQ]

1. What is the running time of a efficient algorithm for finding the shortest path between two vertices in a directed graph? (Assume that all edges are having equal weights, V is set of vertices and E is set of edges)

(a) |V| log |E| (b) |V|
(c) O(|V| + |E|) (d) None of these

[NAT]

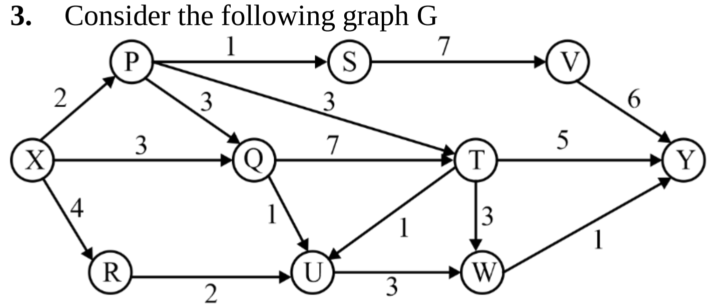
2. Consider the following Graph G:



Apply DFS on G starting at vertex P and selection of adjacent vertex in DFS divided by the Lexicographical order in Graph G, Q and S are adjustment to P. First it selects Q because Q comes first in Lexicographical order. Then what is the number of cross edge when the DFS performed on G is ______.

[NAT]

3. Consider the following graph G



The minimum distance from X to Y is _____ (where X is source and Y is destination)

[MCQ]

4. Consider two strings, S = "AGGTCAK" and T = "GTCACAK". What is the length of the Longest Common Subsequence (LCS) between these two strings?

(a) 2 (b) 3
(c) 4 (d) 5

Q.5 to 8 Carry TWO Mark Each

[MSQ]

5. Which of the following statements is/are false?

(a) In an undirected graph, the shortest path between two nodes always lies on some minimum spanning tree
(b) If every edge of the graph has distinct weight, then highest weight spanning tree is unique.
(c) In Huffman coding, the item with the second lowest probability is always at the leaf that is farthest from the root
(d) in Huffman coding, the item with the highest probability is always at a leaf that is the child of the root.

[MCQ]

6. Consider the statements

S1: Starting from vertex V_0 in a graph, the time required by DFS to find a path (if exists) to some vertex V is less than that is required by BFS.

S2: The space required by DFS is less than that is required by BFS

Which of the following statement is true

(a) Only S1 (b) Only S2
(c) Both S1 and S2 (d) Neither S1 Nor N2 is true

[MCQ]

7. Consider the following matrices with given dimensions

x_1 is 4×6

x_2 is 6×8

x_3 is 8×4

x_4 is 4×5

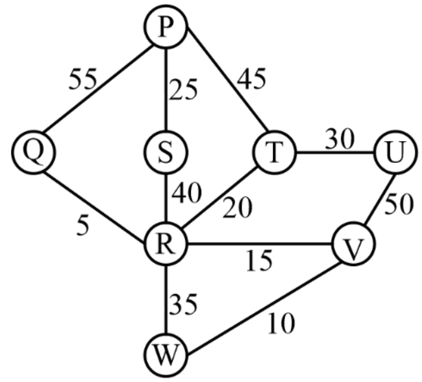
Which of the following multiplication order gives optimal solution.

(a) $((x_1x_2)x_3)\ x_4$ (b) $(x_1\ (x_2\ x_3))\ x_4$

(c) $x_1((x_2\ x_3)\ x_4)$ (d) $(x_1\ x_2)(x_3\ x_4)$

[NAT]

8. Consider the following graph G (starting from P)



The cost of minimum cost spanning tree is ______.

Answer Key

1. **(c)**
2. **(2 to 2)**
3. **(8 to 8)**
4. **(d)**
5. **(a, d)**
6. **(a)**
7. **(b)**
8. **(145 to 145)**

Hints and Solutions

1. (c)

Using BFS by treating all edges as unweighted, it takes O (|V| + |E|) time

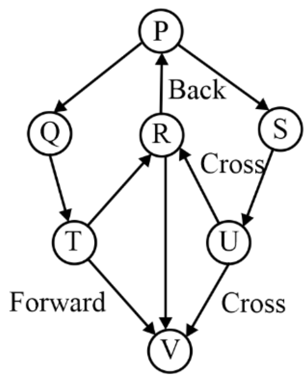
2. (2 to 2)

2 Cross edges in G

1 forward edge in G

1 backward edge in G

∴ Total number of cross edges = 2



3. (8 to 8)

$X \longrightarrow Q \longrightarrow U \longrightarrow W \longrightarrow Y$

Minimum distance = 3 + 1 + 3 + 1 = 8

4. (d)

The given strings are S = "AGGTCAK" and T = "GTCACAK". The Longest Common Subsequence (LCS) is the longest sequence of characters that appears in both strings in the same order.

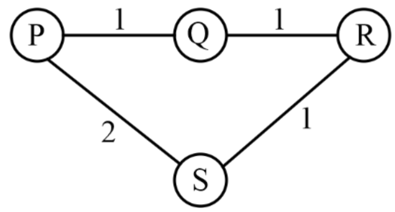
Looking at the strings, we can identify the LCS: "GTCAK". The length of this LCS is 5.

So, the correct answer is d

5. (a, d)

(a) False

Eg:



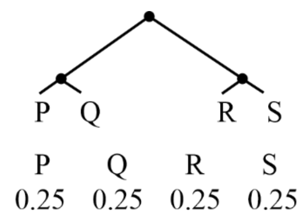
Shortest path: P → S

(b) True: Just by taking negative weight and applying prims' and Kruskal's we get unique weight which is also unique MST.

(c) True: we choose lowest and 2nd lowest for the farther leaves

(d) False:

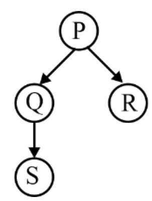
Eg:



6. (a)

Eg:

S1:



P → Q → S → R

Here DFS takes more time

For P to R

BFS → P → Q → R

When far from root → DFS

Near root → BFS

S2: DFS space complexity → O(n) height of graph

BFS space complexity → O(w) → width of graph

Both are unrelated Hence it is false

∴ Only S1 is true

7. (b)

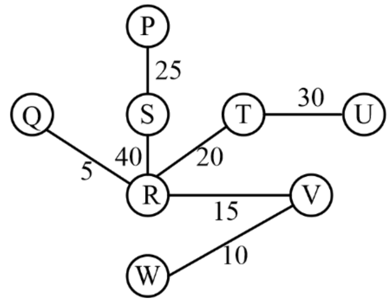
(a) $((x_1x_2)x_3)\ x_4$ required $(4 \times 6 \times 8 + 4 \times 8 \times 4 + 4 \times 4 \times 5)$= 400 multiplications

(b) $(x_1\ (x_2\ x_3))\ x_4$: requires $(6 \times 8 \times 4 + 4 \times 6 \times 4 + 4 \times 4 \times 5)$=368 multiplications

(c) $x_1((x_2\ x_3)\ x_4$ requires $(6 \times 8 \times 4 + 6 \times 4 \times 5 + 4 \times 6 \times 5) = 432$ multiplications

(d) $(x_1\ x_2)(x_3\ x_4)$ requires $4 \times 6 \times 8 + 8 \times 4 \times 5 + 4 \times 8 \times 5 = 512$ multiplication

8. (145 to 145)



$5 + 10 + 15 + 25 + 30 + 40 = 145$

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 01

Subject : C Programming

Maximum Marks 20

Q.1 to 6 Carry ONE Mark Each

[MCQ]

1.
```
#include <stdio.h>
int main(void){
    float x;
    x = 7*2.0/2+10/3;
    printf("%f", x);
    return 0;
}
```
The value of a is ___

(a) 10 (b) 10.0
(c) 10.33 (d) 11.0

[MCQ]

2.
```
#include <stdio.h>
void main()
 {
    int a=0;
    a=printf("Pankaj%dSharma",
    printf("GATE Wallah"));
    printf("%d", a);
 }
```
What will be the output when you compile and run the above code?

(a) GATE Wallah10Pankaj14Sharma
(b) GATE WallahPankaj11Sharma13
(c) GATE WallahPankaj11Sharma14
(d) GATE WallahPankaj10Sharma13

[NAT]

3. Consider the following program.
```
#include<stdio.h>
void main()
 {
    int a;
    a=21>24>17>-10<8>-1>-5!=0;
    printf("%d",a);
 }
```
The output is ___________.

[MCQ]

4.
```
#include < stdio.h>
void main()
 {
    int a = 2, b = –1, c = 0, d;
    d = a -- || b ++ && c ++;
    printf("%d%d%d%d", a, b, c, d);
 }
```
The output string is-

(a) 1–101 (b) –1110
(c) 1–111 (d) 111–1

[NAT]

5. Consider the following program:
```
#include<stdio.h>
void main()
 {
    int x=-2024;
    printf("%d", ~(x=x+5)) ;
    printf("%d", ~(x+1));
 }
```
The sum of the output values printed is ___________.

[MCQ]

6. Consider the following program:
```
#include<stdio.h>
void main()
{
   int a=0, b=1;
   a=(a=5)||(b=0);
   printf("%d", a);
   printf("%d", b);
}
```
The output is:

(a) 50 (b) 51
(c) 11 (d) 10

Q.7 to 13 Carry TWO Mark Each

[MCQ]

7. What will be the output of the C program?

```
#include<stdio.h>
int main()
{
      int a = 3, b = 3, c = 0, d = 1, m;
      m = a-- || b++ && c++ || d--;
      printf("%d %d %d %d %d", a, b, c, d, m);return 0;
}
```

(a) 2 3 1 1 1
(b) 4 4 1 4 1
(c) 4 4 1 4 0
(d) 2 3 0 1 1

[NAT]

8. Consider the following program.

```
#include<stdio.h>
void main()
{
      int a;
      a = printf("Pankaj Sharma") &&
      printf("Wallah") || printf("GATE");
      printf("%d", a);
}
```

The number of characters printed is _______.

[MCQ]

9. Consider the following program:

```
#include<stdio.h>
void main()
{
      int a=2023;
      printf("%d%d%d", a!=2024, a=2021, a==2021);
}
```

The output is-

(a) 120210
(b) 020211
(c) 120211
(d) 020231

[MSQ]

10. If the final value of a = 5, which of the following are invalid combinations?

a = p > q ? r < q ? p : q : r > q ? p : r

(a) p = 5, q = 10, r = 9
(b) p = 10, q = 5, r = 4
(c) p = 5, q = 9, r = 10
(d) p = 10, q = 9, r = 5

[MCQ]

11. Consider the following program.

```
#include <stdio.h>
int main()
{
   char ch=-143;
   printf("%c", ch);
   return 0;
}
```

The output is-

(a) w
(b) q
(c) u
(d) Garbage

[NAT]

12. Consider the following program.

```
#include <stdio.h>
int main()
{
   int c=32780;
   printf("%d", c);
   return 0;
}
```

(Assume the size of integer is specified as of 2 bytes.)

The output is _________.

[MSQ]

13. Which of the following are valid declarations?

(a) unsigned a;
(b) unsigned long a;
(c) unsigned long long int a;
(d) short a;

Answer Key

1. (b)
2. (c)
3. (1)
4. (a)
5. (4035)
6. (c)
7. (d)
8. (20)
9. (a)
10. (a, b, d)
11. (b)
12. (-32756)
13. (a, b, c, d)

Hints and Solutions

1. (b)

x = 7*2.0/2+10/3;
= 14.0/2 + 10/3
= 7.0+3
= 10.0
x is a float variable,
so, x = 10.0

I op I = I
I op F = F
F op I = F
F op F = F

2. (c)

int a=0;
a=printf("Pankaj%dSharma", printf("GATE Wallah"));
// printf prints and returns an integer equal to the number of characters printed. Inner printf is executed first here.
printf("%d", a);
Output: GATE WallahPankaj11Sharma14

3. (1)

a = 21>24>17>-10<8>-1>-5!=0
0 > 17 ⇒ 0 > -10
1 < 8
0 > – 1
1 > -5
1!=0
1
a = 1

4. (a)

d = a -- || b ++ && c ++;
d = a -- || (b ++ && c ++);
// post decrement is used, so the value used is a=2;
d = 2 || (b++ & c++);
↳ never evaluated
d = 1
but because of post decrement, a becomes 1.
Output: 1 -1 0 1

5. (4035)

x = x + 5 → x = –2024 + 5 = –2019
~(x) → ~(–2019) = – (–2019 + 1) = 2018
~(x + 1) → ~(–2019 + 1) = – (–2018 + 1) = 2017
Sum of the values printed = 2018 + 2017 = 4035.

6. (c)

int a=0, b=1;
a=(a=5)||(b=0);
// Assignment operator assigns and returns the assigned value. Here, short-circuiting will be applied. Since the logical operator is OR, if the first part is true, second part is not evaluated at all. Hence, b=1, a=1.
printf("%d", a);//1 is printed
printf("%d", b);//1 is printed.

7. (d)

m = a-- || b++ && c++ || d--
3 || (rest is not evaluated)
= 1
(d) 2 3 0 1 1 is correct

8. (20)

printf prints and returns an integer equal to the number of characters printed.
Due to short-circuiting, printf("GATE") is not executed. Since the logical operator is OR, if the first part is true, second part is not evaluated at all.
Output: Pankaj SharmaWallah1

9. (a)

The expressions are evaluated from right to left but are printed from left to right.
a= =2021 is equivalent to 2023= =2021. So, it evaluates to 0.
a=2021. Assignment operator assigns the value and returns the assigned value.
a=2021. So, a!=2024 evaluates to 1.
Output: 120210

10. (a, b, d)

The only valid combination is (c): p = 5, q = 9, r = 10

$a = p > q \; ? \; r < q \; ? \; p : q : \boxed{r > q \; ? \; p : r}$

$(5 > 9) \downarrow$ False

$(10 > 9) \rightarrow p\,(5)$

$\downarrow$ True

$\therefore$ a = 5

All other combinations are invalid.

11. (b)

Unsigned value for –143= 256 – 143 = 113.

Hence, ‘q’ is printed.

12. (–32756)

32780 is 13 steps ahead of 32767. After 32767, 13 steps are counted from –32768(including 32768) as

Printed value = –32756.

13. (a, b, c, d)

All are valid declarations.

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 02

Subject : C Programming

Maximum Marks 20

Q.1 to 5 Carry ONE Marks Each

[MCQ]

1.
```
#include <stdio.h>
int main()
{
    int i=9;
    for(--i; i--; --i){
    printf("%d\t", i);
    if(i==1) break;
    }
    return 0;
}
```
The output is-

(a) 8 5 2 1 (a) 7 6 4 3 1
(c) 8 6 4 2 1 (d) 7 5 3 1

[MCQ]

2.
```
#include <stdio.h>
int main(void){
    int x ;
    scanf("%d", & x);
    switch(x)
    {
        case 0: x = x + 1;
        break;
        default: x = x - 1;
        case 1: x = x + 99;
        break;
        case 2: x = x + 96;
        break;
    }
    printf("%c", x-32);
    return 0;
    }
```
When x=5, the character printed is-

(a) e (b) G
(c) Garbage value (d) E

[MCQ]

3.
```
#include <stdio.h>
int main()
{
    int a,i;
    a= 12.4/5+33.2/2*5-5;
    for(i=a; i<90;i=i+3)
    {
        printf("%c\t", i+32);
    }
    return 0;
}
```
The output is-

(a) p s v y (a) K L M N O
(c) k n q t w (d) P U V W

[MCQ]

4.
```
#include<stdio.h>
int main()
{
    int i=2023, j=2;
```

```
    for(;j<i;j*=8)
    {
        i+=1;
        printf("GATE Wallah 2023\n");
    }
    return 0;

}
```

The number of times 'GATE Wallah 2023' is printed is-

(a) 3 (b) 2
(c) 4 (d) 5

[MCQ]

5. #include<stdio.h>

```
void main()
{
int x=5;
if(printf("%d",x>>1)-3)
for(;x--;x--) break;
else;
printf("\t%d", x);
}
```

The output is-

(a) Compiler Error
(b) 1
(c) Infinite Loop
(d) 2 4

[MCQ]

6. #include <stdio.h>

```
int main()
{
int a = 10 > 9 ? 0 ? 3 : -2 : 5;
if(a = a + 1)
printf("GATE 2023");
else
printf("GATE WALLAH");
return 0;
}
```

The output is-

(a) GATE 2023
(b) GATE WALLAH
(c) Compiler error
(d) Garbage value

Q.7 to 13 Carry TWO Marks Each

[NAT]

7. Consider the following program:

```
#include<stdio.h>
int main()
{
    int p,j=0;
    for(p=2;p<=100 && j<3;p*=2){
     switch(p+j){
     case 1: p+=3;
     break;
     case 2: p+=5;
     break;
     case 3: p+=7;
     default: p+=8;
     break;
     }
     j++;
     printf("%d\n",p);
     }
  return 0;
}
```

The sum of the values printed is ________________

[NAT]

8. #include <stdio.h>

```
int main()
{
    int i=printf("best hai GATE Wallah");
    while(i>=3){
```

```
        if(i%3!=0) i=i-5;
        else i=i+2;
        printf("Pankaj Sharma\n");
        }
        return 0;
    }
```

The number of times printf() is executed is______.

[MCQ]

9. #include <stdio.h>

```
int main()
    {
     int i, j=4, k=3;
     i=j++<--k?++j:k--;
     for(++i; ++i; ++i){
     printf("%d\t", i);
     if(i>8) break;
    }
     return 0;
}
```

The output is-

(a) 2 4 6 8 (a) 4 6 8
(c) 4 6 8 10 (d) 2 4 6

[MCQ]

10. #include<stdio.h>

```
int main()
    {
     int a=2, b=4;
     while(a++<=b--);
     printf("%d\t", a);
     printf("%d", b);
     return 0;
    }
```

The output is –

(a) 4 2 (b) 4 1
(c) 5 2 (d) 5 1

[NAT]

11. #include<stdio.h>

```
int main()
  {
 int a=0, b=1;
 while(++a<=5){
do{
      b+=2;
}while(b++<=10);
}
return 0;
}
```

The sum of the values of a and b is ______.

[MSQ]

12. #include <stdio.h>

```
int main()
{
    int x=-5;
    do
    {
       printf("%d\t", ~(x+2));
       x++;
    }while(~(x+1)%2==0);
    printf("%d", x);
    return 0;
}
```

Which of the following values will be displayed in the output?

(a) 2 (b) 1
(c) –3 (d) – 4

[MSQ]

13. #include <stdio.h>

```
int main()
{
    int i, n, count=0;
    for(i=1;i<=n;i=i*3)
    count=count+i;
    printf("%d", count);
    return 0;
}
```

Which of the following CANNOT represent the final value of the COUNT variable?

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

(c) lon_3n (d) log_3log_3n

Answer Key

1. (d)
2. (b)
3. (a)
4. (c)
5. (d)
6. (a)
7. (81)
8. (12)
9. (c)
10. (d)
11. (31)
12. (a, b, c)
13. (a, b, c, d)

Hint & Solutions

1. (d)

Sol. for (--i; i --; --i){

```
        ↓    ↓  ↓
        8    8  6
             6  4
             4  2
             2
     printf("%d\t", i);//7 5 3 1
     if(i==1) break; //Loop terminated
}
```

Output is : 7 5 3 1

2. (b)

Sol. When, x=5, default is executed. As no break statement is there after default, case 1 is also evaluated.

x=5-1=4
x=4+99=103

Printed character is the character with ASCII (103-32) i.e 71.

3. (a)

a = 12.4/5+33.2/2*5-5

a = 80.48

$\because$ a is integer

$\therefore$ a = 80

The for loop converts each character to lower case corresponding to the ASCII values.

Output ASCII : (80 + 32) (83 + 32) (86 + 32) (89+32)

Output characters : p s v y

4. (c)

Sol. for (j = 2; j < i ; j = j $*$ 8)

2 < 2023 → true

i = 2024;
printf( ) → executed
j = 16

16 < 2024 → true
i = 2025;
printf( ) → executed
j = 128

128 < 2025 → true
i = 2026;
printf( ) → executed
j = 1024

1024 < 2026 → true
i = 2027;
printf( ) → executed
j = 8192

8192 < 2027 → false; //Loop terminated.

5. (d)

Sol. x=5

if(printf("%d",x>>1)-3)
5>>1= 2
printf() prints and returns the number of characters it successfully printed. 2 is printed and printf() returns 1.
Condition is evaluated as-(1-3) = -2 i.e. TRUE.
for(;x--;x--) break; is evaluated.

```
     ↓
     5
```

Condition is True. x is decremented to 4. Then break is executed.
printf("\t%d", x); //4 is printed.

Output: 2 4

6. (a)

Sol. a = 10 > 9 ? 0 ? 3 : -2 : 5;

10>9 is TRUE and 0 is False, so a=-2

Now the assignment operator assigns and returns the value. So, a=-2+1=-1; Hence, condition becomes true, "GATE 2023" is printed.

7. (81)

Sol. P $\boxed{\cancel{2}\ \cancel{7}\ \cancel{1}4\ \cancel{2}2\ \cancel{4}4\ \cancel{5}2}$ 104 j $\boxed{\cancel{0}\ \cancel{1}\ \cancel{2}}$ 3

switch (2 + 0) –
case 2: ✓ p + = 5
 p = 7 * 2 = 14 → 7 is printed
switch (14 + 1) –
 default: ✓ p += 8 → 22 printed

p = 22 ∗ 2 = 44

switch (44 + 2) –

default: ✓ p += 8 → 52 is printed

52 ∗ 2 = 104

104 < = 100 → false

∴ sum of printed values = 7 + 22 + 52 = 81

8. (12)

Sol. printf() prints and returns the number of characters it printed. "best hai GATE Wallah" is printed.

i=20;

The iteration while() executes for i=20, 15, 17, 12, 14, 9, 11, 6, 8, 3, 5.

"Pankaj Sharma" is executed for the above 11 values of i.

The number of times printf() executed is 12.

9. (c)

Sol. i=j++<--k?++j:k--; //4<2-> TRUE, so, k—is evaluated. i takes the value 2.

i = 2, k=1, j=5;

for (++i; ++i; ++i)

{

↓↓↓

34 5

6 7

8 9

10

printf ("%d\t", i); // 4 6 8 10

if(i > 8) break;

10 > 8 → break

}

Output: 4 6 8 10

10. (d)

Sol.

a $\boxed{\cancel{2}\ \cancel{3}\ \cancel{4}\ 5}$ b $\boxed{\cancel{4}\ \cancel{3}\ \cancel{2}\ 1}$

while (a++ < = b – –);

2 < = 4 → True

3 < = 3 → True

4 < = 2 → True

∴ Post – decrement / increment operator assigns and then decrements / increments.

∴ a $\boxed{5}$ b $\boxed{1}$

∴ Output is : 5 1

11. (31)

a $\boxed{\cancel{0}\ \cancel{1}\ \cancel{2}\ \cancel{3}\ \cancel{4}\ \cancel{5}\ 6}$

b $\boxed{\cancel{1}\ \cancel{3}\ \cancel{4}\ \cancel{6}\ \cancel{7}\ \cancel{9}\ \cancel{10}\ \cancel{12}\ \cancel{13}\ \cancel{15}\ \cancel{16}\ \cancel{18}\ \cancel{19}\ \cancel{21}\ \cancel{22}\ \cancel{24}\ \cancel{25}}$

while (++a < = 5)

{

do {

1 < = 5 → True

2 < = 5 → True

3 < = 5 → True

4 < = 5 → True

5 < = 5 → True

6 < = 5 → False

b = b + 2;

1 + 2 → 3	10 + 2 → 12	19 + 2 = 21
4 + 2 → 6	13 + 2 → 15	22 + 2 = 24
7 + 2 → 9	16 + 2 → 18	

}

while (b ++ < = 10);

3 < = 10 → true

6 < = 10 → true

9 < = 10 → true

12 < = 10 → False

15 < = 10 → False

18 < = 10 → False

21 < = 10 → False

24 < = 10 → False

Final value –

∴ a $\boxed{6}$ b $\boxed{25}$

Sum = a + b = 6 + 25 = 31

12. (a, b, c)

~(x+2) i.e -(-5+2+1)=2 is printed.

x++; //x=-4

~(x+1)=2. (~(x+1)%2==0) condition becomes TRUE.

~(x+2) i.e -(-4+2+1)=1 is printed.

x++; //x=-3

~(x+1)=1. (~(x+1)%2==0) condition becomes FALSE.

Loop terminates.
printf("%d", x);//-3 is printed.

Output: 2 1 -3

13. (a, b, c, d)
None of the options are correct.

❑❑❑

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 03

Subject : Programming in C

Topic : Functions and Storage Classes

Maximum Marks 20

Q.1 to 6 Carry ONE Mark Each

[MCQ]

1. Consider the following program:

```
#include<stdio.h>
int func(int i){
   i-=3;
   return i;
}
void main(){
   int i=printf("Parakram 2024");
   i=func(i=func(i=func(--i)));
   printf("%d", i);
}
```

The output is-

(a) Parakram 20243
(b) Parakram 20246
(c) Parakram 20249
(d) Parakram 2024

[MCQ]

2. Consider the following program:

```
#include<stdio.h>
int a=5;
extern int a;
void main(){
   for(;--a>0;a--)
   printf("GATE Wallah");
}
```

The output is:

(a) “GATE Wallah” is printed 4 times.
(b) “GATE Wallah” is printed 2 times.
(c) “GATE Wallah” is printed 5 times.
(d) Compilation error.

[MSQ]

3. Which of the following statements is/are CORRECT?

(a) A static variable has internal linkage.
(b) Default value of register variable is garbage.
(c) Default value of global variable is garbage.
(d) An extern variable can be declared multiple times in a program.

[MCQ]

4. Consider the following two statements:

```
P: int a=2;
   static int b=a;
Q: static int j;
    static int j=1;
```

Which of the following statements is/are INCORRECT?

(a) Neither P nor Q
(b) P only
(c) Q only
(d) Both P and Q.

[MCQ]

5.

```
#include<stdio.h>
void arc(int n){
   if (n<=2) return;
   else{
      arc(n-2);
      printf("%d\t", n-1);
   }
}
int main(){
        arc(9);
        return 0;
}
```

The output printed is-

(a) 2 4 6 8
(b) 4 6 8 10
(c) 8 6 4 2
(d) 7 9 11 13

[MCQ]

6.
```
#include<stdio.h>
int main(){
  int p=3;
  {
    int p=6;
      printf("%d\t", --p);
  }
    {
      printf("%d\t",--p);
      int p=7; {p--;}
      printf("%d\t", p--);
    }
  printf("%d", --p);
  return 0;
}
```
The output printed is-

(a) 1 6 2 5 (b) 5 10 6 2

(c) 5 2 6 1 (d) 5 6 1 10

Q.7 to 13 Carry TWO Mark Each

[NAT]

7.
```
int func(int a){
   static int i=3;
   if(a<4) return a+i++;
   a=a-i--;
   return func(a)+i;
}
```
What is the value returned by func(9)? _____________

[NAT]

8.
```
int func(int a, int b){
   static int p, q=1;
   if(a>=b){
      a=a-++p;
      b=b+--q;
      return func(a,b)+p;
   }else return p-q;
}
```
The value returned by func(4, 3) is ________________.

[MCQ]

9.
```
#include<stdio.h>
int func(int a){
   static int x=2;
   if(a>7) return a;
   a=a+x;
   x++;
   return func(a);
}
```
The value returned by func(1) is-

(a) 7 (b) 8

(c) 10 (d) 12

[NAT]

10.
```
#include<stdio.h>
int func(int n){
   int i, j=1;
   if(n<1) return j;
   for(i=2;i<n;i*=2)
   j+=func(i)+func(n-i);
   return j;
}
```
The value returned by func(5) is _______

[NAT]

11. Consider the following program:
```
#include<stdio.h>
void func(int a){
   static int i=7;
   if(a<=1) return;
   printf("%d\t",i--);
   a=a-i--;
   printf("%d\t",a);
   func(a-2);
   printf("%d\t",i++);
}
```

```
int main(){
   func(10);
   return 0;
}
```

The sum of the values printed is_____________

[MSQ]

12.
```
int func(int k){
   static int i=10;
   int j;
   if(i==k){
      printf("Pankaj Sharma");
      j=func(i);
      return 0;
   }
   return 0;
}
```

Which of the following statement(s) is/are CORRECT?

(a) The function returns 0 for all values of k.

(b) The function doesn't print "Pankaj Sharma" for all values of k.

(c) The functions prints "Pankaj Sharma" infinitely or gives stack overflow error when k=10.

(d) The function returns 0 if k=10;

[MCQ]

13.
```
int func(int a, int b){
if(a>0)
   return a%b + func(a/b, b/4);
   else return 0;
}
```

The value returned by func(347, 32) is-

(a) 12 (b) 30

(c) 18 (d) 10

Answer Key

1. (a)
2. (b)
3. (a, b, d)
4. (d)
5. (a)
6. (c)
7. (6)
8. (7)
9. (c)
10. (9)
11. (21)
12. (b, c)
13. (b)

Hints and Solutions

1. (a)

```
void main(){
   int i=printf("Parakram 2024");//i=13
   i=func(i=func(i=func(--i)));
  //func(--i) i.e func(12) returns 9.
   //func(i=9) i.e func(9) returns 6.
  //func(i=6) i.e func(6) returns 3.
   printf("%d", i);//3
}
```

Output: Parakram 20243

2. (b)

```
#include<stdio.h>
int a=5;
extern int a;//It will not give any compilation error.
void main(){
   for(;--a>0;a--)//the loop executes two times.
   printf("GATE Wallah");
}
```

"GATE Wallah" is printed 2 times.

3. (a, b, d)

(a) CORRECT. A static variable has internal linkage.

(b) CORRECT. Default value of register variable is garbage.

(c) INCORRECT. Default value of global variable is zero.

(d) CORRECT. An extern variable can be declared multiple times in a program.

4. (d)

P is not allowed. We can initialize a static variable with a constant only.
Q is not allowed if the static variable j has local scope.

5. (a)

arc(9) n | 9

1. if (n < = 2) → false
2. arc(9 – 2);
3. printf("8");

arc(7) n | 7

1. if (n < = 2) → false
2. arc(5)
3. printf("6");

arc(5) n | 5

1. if (n < = 2) → false
2. arc(3)
3. printf("4");

arc(3) n | 3

1. if (n < = 2) → false
2. arc(1)
3. printf("2");

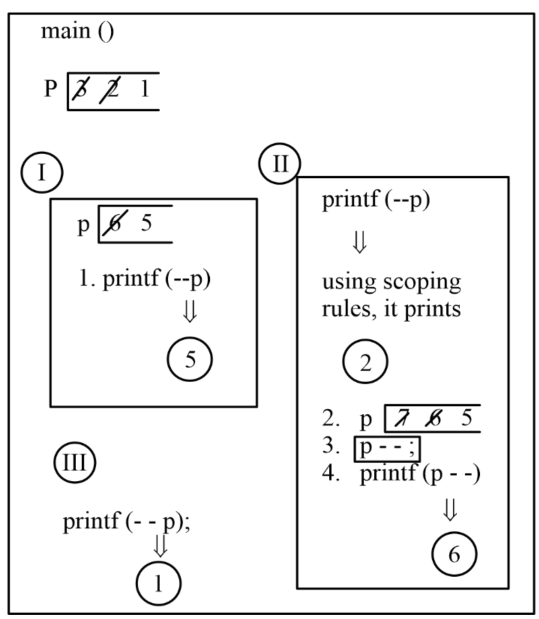
arc(1) n | 1

1. return

Output:

2 4 6 8

6. (c)



Output is: 5 2 6 1

7. (6)

```
int func(int a){
   static int i=3;
   if(a<4) return a+i++;//line 1
   a=a-i--;//line 2
   return func(a)+i;//line 3
}
```

func(9):

Line1: 9<4 → FALSE

Line2: a=a-i--; a=9-3=6; static i is decremented to 2.

Line3: Call func(6);

return (5+1);//return 6

func(6):

Line1: 6<4 → FALSE

Line2: a=a-i--; a=6-2=4; static i is decremented to 1.

Line3: Call func(4);

return (4+1);//return 5 to func(9)

func(4):

Line1: 4<4 → FALSE

Line2: a=a-i--; a=4-1=3; static i is decremented to 0.

Line3: Call func(3);

return (3+1);//return 4 to func(6)

func(3):

Line1: 3<4 → TRUE; return a+i++;

//return (3+0) to func(4) then static i is incremented to 1.

8. (7)

```
int func(int a, int b){
   static int p, q=1;
   if(a>=b){ //Line 1
      a=a-++p;//Line 2
      b=b+--q;//Line 3
      return func(a,b)+p;//Line 4
   }else return p-q;//Line 5
}
```

func(4, 3)://a=4, b=3

Line1: 4>=3 → TRUE

Line2: a=a-++p; //a=4-1=3;

Line3: b=b+--q;//b=3+0=3;

Line4: return func(3, 3)+2; // **return 5+2 i.e 7**

func(3, 3)://a=3, b=3

Line1: 3>=3 → TRUE

Line2: a=a-++p; //a=3-2=1;

Line3: b=b+--q;//b=3-1=2;.

Line4: return func(1,2)+2; // return 3+2 i.e 5

func(1, 2):

Line1: 1>=2 → FALSE

Line5: return p-q; // return 2+1 i.e return 3.

9. (c)

func(1):

static int x=2;

if(a>7) return a;//1>7 is FALSE

a=a+x; //a=1+2=3

x++;//static x is incremented to 3.

return func(a);// func(3) is called.

func(3):

if(a>7) return a;//3>7 is FALSE

a=a+x; //a=3+3=6

x++;//static x is incremented to 4.

return func(a);// func(6) is called.

func(6):

if(a>7) return a;//6>7 is FALSE

a=a+x; //a=6+4=10

x++;//static x is incremented to 5.

return func(a);// func(10) is called.

func(10):

if(a>7) return a;//10>7 is TRUE, so, **10 is returned.**

Output: 10

10. (9)

func(5):

n=5; j=1;

if(n<1) return j; //5<1 is FALSE

for i=2:

j+=func(i)+func(n-i);//j=j+func(2)+func(3);

func(2) returns 1, func(3) returns 3.So, j=1+1+3=5

for i=4:

j+=func(i)+func(n-i);//j=j+func(4)+func(1);

func(1) returns 1, func(4) returns 3.So, j=5+3+1=9

return j; //**return 9;**

11. (21)

func(8):

if(a<=1) return; //8<=1: FALSE

1. printf("%d\t",i--);//7 is printed, static i is decremented to 6.

a=a-i--;//a=10-6=4; static i is decremented to 5.

2. printf("%d\t",a);//4 is printed.

func(a-2);//func(2) is called.

6. printf("%d\t",i++);//4 is printed, static i is incremented to 5.

func(2):

if(a<=1) return; //2<=1: FALSE

3. printf("%d\t",i--);//5 is printed, static i is decremented to 4.

a=a-i--;//a=2-4=-2; static i is decremented to 3.

4. printf("%d\t",a);//-2 is printed.

func(a-2);//func(0) is called. It simply returns.

5. printf("%d\t",i++); //3 is printed, static i is incremented to 4.

Output: 7 4 5 -2 3 4

Sum: 21

12. (b, c)

When k!=10, then the functions returns 0. So, (a, d) are INCORRECT.

The function prints “Pankaj Sharma” for k=10. So, b is correct.

The function prints “Pankaj Sharma” for k=10 infinite times or until runtime stack overflows. So, (c) is correct.

13. (b)

func(347, 32): //a=347, b=32

if(a>0) //347>0 $\rightarrow$ TRUE

return a%b + func(a/b, b/4);//func(10, 8) is called. So, 27+3 i.e **30 is returned**

func(10, 8): //a=10, b=8

if(a>0) //10>0 $\rightarrow$ TRUE

return a%b + func(a/b, b/4);//func(1, 2) is called. So, 2+1 is returned

func(1, 2): //a=1, b=2

if(a>0) //1>0 $\rightarrow$ TRUE

return a%b + func(a/b, b/4);//func(0, 0) is called. So, 1+0 is returned.

func(0, 0) returns 0;

Branch : CSE & IT   Batch:Hinglish

WEEKLY TEST – 04

Subject : Programming in C

Topic : Recursion and arrays

Maximum Marks 20

Q.1 to 6 Carry ONE Mark Each

[MCQ]

1. Consider the following program:

```
#include <stdio.h>
int main()
{
  int b[5]={1, 2, 3, 4, 5};
  int *ptr[5]={b+3, b+2, b, b+1, b+4};
  int **q=ptr;
  *++*q;
  printf("%d\t%d\t%d", q-ptr, *q-b, **q);
  return 0;
}
```

The output of the program is-

(a) 0 1 2   (b) 0 4 5

(c) 1 2 3   (d) Compilation error.

[NAT]

2. Consider the following function:

```
void f(int n)
{
  if(n<2) {printf("%d", n-3); return;}
  printf("%d", n-2);
  f(n-1);
}
```

The sum of all the values printed when f(7) is called is ________.

[MCQ]

3. Consider the following program:

```
#include <stdio.h>
int main()
{
  int b[5]={1, 2, 3, 4, 5};
  int *ptr[5]={b+3, b+2, b, b+1, b+4};
  int **q=&ptr[3];
  --**q;
  printf("%d\t%d\t%d", q-ptr, *q-b, **q);
  return 0;
}
```

The output is-

(a) Compilation error

(b) 3 1 3

(c) 2 1 2

(d) 3 1 1

[MCQ]

4. Consider the following program:

```
#include <stdio.h>
int main()
{
    int b[3]={6, 12, 20};
    int *ptr[3]={b, b+2, b+1};
    printf("%d", *ptr[*ptr[1]-*ptr[2]-8]);
    return 0;
}
```

The output is:

(a) Segmentation Fault

(b) Compilation Error

(c) 6

(d) 12

[NAT]

5. Consider the following function:

```
int f(int x)
{
   if(x<=1) return x;
   if(x%3) return f(x/3)+x;
   return f(x/2)+x;
}
```

The value returned by f(24) is________.

[MCQ]

6. Consider the following program:

```
#include <stdio.h>
int main()
{
    int a[][3][2]={0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11};
    printf("%u\t", a);
    printf("%u\t", **a+1);
    printf("%u\t", *(*(*a+2))+1);
```

```
    printf("%u\t", a+1);
    return 0;
}
```
Assume array index starts from 1000 and integer size is 2 bytes.

The output is-
(a) 1000 1002 5 1012
(b) 1000 1004 6 1012
(c) 1000 1008 7 1024
(d) 1000 1012 7 1024

Q.7 to 13 Carry TWO Mark Each

[NAT]

7. Consider the following program:
```
#include <stdio.h>
void func(int *q)
{
   int *p;
   p=q++;
   *q=*q-*p;
   *p=*p-1;
}
int main()
{
   int i;
   int a[][3]={0, 1, 2, 3, 4, 5, 6, 7, 8};
   for(i=0;i<2;i++)
   func(a[i]);
   return 0;
}
```
The sum of elements of the first two rows of the array is____________.

[NAT]

8. Consider the following program:
```
#include<stdio.h>
int f(int *arr, int n)
{
  int c;
  if(n<=1) return *arr-n;
  else if(*arr%5==0)
      return *(arr+1) - f(arr+1, n-1);
  else
      return *arr + f(arr+1, n-1);
}
int main(){
   int a[]={1, 2, 5, 10};
   printf("%d",f(a,sizeof(a)/sizeof(a[0])));
   return 0;
}
```
The output is_________.

[NAT]

9. Consider the following program:
```
#include<stdio.h>
int main()
{
  int a[]={7, 2, 5, 10, 13};
  int count=1, i=4;
  while(i){
  count=count+(*(a+i)-i);
  i--;
 }
 printf("%d", count);
 return 0;
}
```
The output is___________.

[MCQ]

10. Consider the following program:
```
#include <stdio.h>
void doSomething(int **p)
{
   **p++;
   printf("%d\t", **p);
}
int main()
{
   int b[5]={6, 12, 20, 13, 7};
   int *ptr[5]={b+4, b+3, b+2, b+1, b};
   int i;
   for(i=0;i<4; i++)
   doSomething(ptr+i);
   return 0;
}
```
The output is-

(a) 13 12 6 20 (b) 13 20 12 6
(c) 7 20 12 13 (d) 20 12 13 7

[MCQ]

11. Consider the following function:
```
int func(int n)
{
   static int i=1, j;
   if(n<0) return 0;
   j+=func(n-i);
   i+=2;
   return j+n;
}
```
The above function computes-

(a) x^2+2x+1 (b) 2^x+1
(c) 2^x-1 (d) 2^x

[NAT]

12. Consider the following function:

```
int func(int a)
{
   static int x;
   if(a>5) return a-x--;
   a=a+x++;
   return func(a)+x;
}
```

The value returned by func(4) is__________.

[MCQ]

13. Consider the following program:

```
#include <stdio.h>
void doSomething(int **p)
{
   printf("%u\t", p[1][1]);
   printf("%u\t", *p[1]);
   printf("%u\t", *(*(p+2)+1));
   printf("%u\t",**p+3);
   printf("%u",*(*p+3));
}
int main()
{
   int a[]={1, 2, 13, 7};
   int b[]={3, 9, 6};
   int c[]={4, 5, 7};
   int *arr[]={a, b, c};
  doSomething(arr);
  return 0;
}
```

The output is:

(a) 9 5 3 4 7 (b) 3 5 9 7 4
(c) 9 3 5 7 7 (d) 9 3 5 4 7

Answer Key

1. (b)
2. (13)
3. (d)
4. (c)
5. (46)
6. (a)
7. (10)
8. (4)
9. (21)
10. (b)
11. (c)
12. (10)
13. (d)

Hints and Solutions

1. (b)

1000	1002	1004	1006	1008
1	2	3	4	5

2000	2004	2008	2012	2016
~~1006~~1008	1004	1000	1002	1008

3000
2000

*++*q;//*++*2000 = *++1006 =*1008
printf("%d\t%d\t%d", q-ptr, *q-b, **q);
q-ptr= (2000-2000)/4 = 0/4 =0
*q-b = *2000-1000= (1008-1000)/2=4
q=2000=*1008=5

2. (13)

The printed values are:

5 4 3 2 1 0 -2

Sum: 13

3. (d)

1000	1002	1004	1006	1008
1	~~2~~ 1	3	4	5

2000	2004	2008	2012	2016
1006	1004	1000	1002	1008

3000
2012

--**q;//--**2012 = --*1002 =*1008
printf("%d\t%d\t%d", q-ptr, *q-b, **q);
q-ptr= (2012-2000)/4 = 12/4 =3
*q-b = *2012-1000= (1002-1000)/2=1
q=2012=*1002=1

4. (c)

1000	1002	1004
6	12	20

2000	2004	2008
1000	1004	1002

=*ptr[*ptr[1]-*ptr[2]-8]
=*ptr[*1004-*1002-8]
=*ptr[20-12-8]
=*ptr[0]
=*1000
=6

5. (46)

24%3 is 0. Return f(24/2)+24. Return 22+24 i.e 46
12%3 is 0. Return f(12/2)+12. Return 10+12 i.e 22
6%3 is 0. Return f(6/2)+6. Return 4+6 i.e 10
3%3 is 0. Return f(3/2)+3. Return 1+3 i.e 4
1%3 is 1. Return f(1/3)+1. Return 1

6. (a)

printf("%u\t", a);//It points to the 0th 3D array.

printf("%u\t", **a+1); //It points to the 1st element of the 0th row of the 0th 3D array. So, 1002 is printed.

printf("%u\t", *(*(*a+2))+1); //It is the 1st element of the 2nd row of the 0th 3D array. So, 5 is printed.

printf("%u\t", a+1);//It points to the 1st 3D array. So, 1012 is printed.

7. (10)

1000	1002	1004	1006
1	2	5	10

The given function func(*q)is called for the 0th and 1st row of the 2D array.
It decrements the 0th element of a row by 1. It subtracts the value of the 0th element from the 1st element in any row. So, the two rows are-
-1 1 2
2 1 5
Sum: 10

8. (4)

sizeof(a)/sizeof(a[0]) gives the size of the array. Size of the array is 4.

f(0,4):

Line1: arr=100, n=4;

Line2: 4<=1->FALSE;

Line3:*arr i.e 1%5!=0, so else part is executed.

f(*arr+1, n-1)=f(102,3) =3

*arr+f(*arr+1, n-1)=1+3=4

return 4; //return 4 to main

f(102,3):

Line1: arr=102, n=3;

Line2: 3<=1->FALSE;

Line3:*arr i.e 2%5!=0, so else part is executed.

f(*arr+1, n-1)=f(104,2) =1

*arr+c=2+1 i.e 3

return 3; //return 3 to Line3 of f(100,4)

f(104,2):

Line1: arr=104, n=2;

Line2: 2<=1->FALSE;

Line3:*arr i.e 5%5==0, so else if part is executed.

f(*arr+1, n-1)=f(106,1)=9

*(arr+1)-c=(10-9) i.e 1

return 1; //return 1 to Line3 of f(102,3)

f(106,1):

Line1: arr=106, n=1;

Line2: 1<=1->TRUE; //Return *arr-n i.e. (10-1) i.e 9 to Line3 of f(104,2)

Output: 4

9. (21)

1000	1002	1004	1006	1008
7	2	5	10	13

count	1

while(4)

{

count=count+(*(a+4)-4);//(*(1008)-4)=9;

count=1+9=10

i--;//i=3

}

while(3)

{

count=count+(*(a+3)-3);//(*(1006)-3)=7;

count=10+7=17

i--;//i=2

}

while(2)

{

count=count+(*(a+2)-2);//(*(1004)-2)=3;

count=17+3=20

i--;//i=1

}

while(1)

{

count=count+(*(a+1)-1);//(*(1002)-1)=1;

count=20+1=21

i--;//i=1

}

printf("%d", count);//21 is printed.

10. (b)

1000	1002	1004	1006	1008
6	12	20	13	7

2000	2004	2008	2012	2016
1008	1006	1004	1002	1000

For i=0:

doSomething(2000+0):

p=2000

**p++;//p=2004

printf("%d\t", **p);//**2004= 13 is printed.

For i=1:

doSomething(2000+1):

p=2004

**p++;//p=2008

printf("%d\t", **p);//**2008= 20 is printed.

For i=2:

doSomething(2000+2):

p=2008

**p++;//p=2012

printf("%d\t", **p);//**2012= 12 is printed.

For i=3:

doSomething(2000+3):

p=2012

**p++;//p=2016

printf("%d\t", **p);//**2016= 6 is printed.

Output: 13 20 12 6

11. (c)

The above function computes 2^x-1.

12. (10)

func(4):

a=a+x++; //a=4+0=4. Static x is incremented to 1.

return func(4)+x; return 10

func(4):

a=a+x++; //a=4+1=5. Static x is incremented to 2.

return func(5)+x; return 6+2; return 8

func(5):

a=a+x++; //a=5+2=7. Static x is incremented to 3.

return func(7)+x; return 6

func(7):

return a-x--;

return 7-3=4; x is decremented to 2.

13. (d)

1000	1002	1004	1006
1	2	13	7
2000	2002	2004	
3	9	6	
3000	3002	3004	
4	5	7	
4000	4004	4008	

1000	2000	3000

doSomething(4000):

p	4000

printf("%u\t", p[1][1]);
//*(*(p+1)+1)=*(*(4000+1)+1)=*(*4004+1)=*(2000+ 1)=*2002=9
printf("%u\t", *p[1]);//**(p+1)=**(4000+1)=**4004=*2000=3
printf("%u\t", *(*(p+2)+1));= *(*(4000+2)+1)= *(*4008+1)=*(3000+1)=*3002=5
printf("%u\t",**p+3);=**4000+3=*1000+3=1+3=4
printf("%u",*(*p+3));=*(*4000+3)=*(1000+3) =*1006=7
Output: 9 3 5 4 7

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 05

Subject : Programming in C

Topic : Arrays and Pointers

Maximum Marks 20

Q.1 to 6 Carry ONE Mark Each

[MCQ]

1. Consider the following statements:

```
P: int a[2]={5,10};
   printf("%d", 1[a]);
Q: int 2[a]={5,10};
    printf("%d", 1[a]);
```

Which of the following statement(s) is/are INCORRECT?

(a) Both P and Q

(b) P only

(c) Q only

(d) Neither P nor Q

[MSQ]

2. Which of the following declaration(s) is/are NOT allowed?

(a) int b[][]={1,2,3,4};

(b) int b[][2][2]={1};

(c) int b[]={1};

(d) int b[][3];

[MCQ]

3. Consider the following program:

```
#include <stdio.h>

int main()

{

   int a[3][4]={1,2,3,4,5,6,7,8,9,10,11,12};

   printf("%d",*(*(a+**a+1)+2)+3);

   return 0;

}
```

The output is-

(a) 11 (b) 12

(c) 14 (d) Compilation Error

[NAT]

4. Consider the following program:

```
#include <stdio.h>

int main()

{

   int a[]={1,3,5,7,9};

   int i, count=0;

   int *b=a+4;

   for(i=0;i<3;i++)

   count=count+(*b---i);

   return 0;

}
```

The final value of count is ________.

[MCQ]

5. Consider the following program:

```
#include <stdio.h>

int main()

{

   int a[]={1, 2, 3, 4, 5};

   int *ptr=a;

    ptr+=sizeof(2*a[0]);

    printf("%d",*(ptr-2));

    return 0;
```

```
}
```

(Assume, integer size is 4 bytes)

The output is-

(a) 4 (b) 3
(c) Garbage value (d) Compilation Error

[MCQ]

6. Consider the following codes:

P: int *p=NULL;
printf("%d", *p);

Q: int *p;
*p=10;
printf("%d", *p);

Which of the following is CORRECT?

(a) Neither P nor Q is valid.
(b) Only P is valid.
(c) Only Q is valid.
(d) Both P and Q are valid.

Q.7 to 13 Carry TWO Mark Each

[MCQ]

7. Consider the following program: 2 Marks

```
#include <stdio.h>
#include <stdlib.h>
int main() {
int i;
int *p=(int*)malloc(3*sizeof(int));
for(i=0;i<3;i++)
*(p+i)=3-i;
int *q=p;
printf("%u\t",*++p);
printf("%u\t", ++*p);
printf("%u\t", p-q);
return 0;
}
```

The output is-

(a) 1 2 3 (b) 3 2 1
(c) 2 2 1 (d) 2 3 1

[MCQ]

8. Consider the following program:

```
#include <stdio.h>
#include <stdlib.h>
int main() {
void *p, *q;
int k=97;
char b='C';
p=&k;
q=&b;
printf("%d", *(char*)p-*(char *)q);
return 0;
}
```

The output is-

(a) Garbage value
(b) Compilation error
(c) 30
(d) No output

[MCQ]

9. Consider the following program:

```
#include <stdio.h>
int func(int *p, int n){
int sum=*(p+4);
for(int i=1;i<n-2;i++){
sum=sum+*(p+i)+*p++;
}
```

```
return sum;
}
int main()
{
   int a[]={7, 1, 3, 5, 2};
   int (*ptr)(int *, int)=func;
   printf("%d",(*ptr)(a, 5));
   return 0;
}
```

The output is-

(a) 16
(b) 23
(c) Garbage value
(d) Compilation Error

[MCQ]

10. Consider the following functions:

```
P:  int * f1(){
        int x=10;
        return &x;
    }
Q:  int *f2(){
        static int x=10;
        return &x;
    }
R:  int *f3(){
        int x=10;
        int *p=&x;
        return *p;
    }
```

Which of the given functions is/are VALID?

(a) P
(b) Q
(c) R
(d) P and R

[NAT]

11. Consider the following program:

```
#include <stdio.h>
void func(int *p)
{
   ++*p++;
   ++*++p;
}
int main()
{
   int a[]={5,4,3,2,1};
   func(a+2);
   printf("%d",a[2]+a[3]+a[4]);
   return 0;
}
```

The output is _______.

[MCQ]

12. Consider the following program:

```
#include <stdio.h>
int f(int (*ptr)[3], int n)
{
   if(n<=1) return 0;
   return f(ptr+1, n-1)+**ptr;
}
int main()
{
   int a[][3]={1,2,3,4,5,6,7,8,9};
   printf("%d",f(a,3));
   return 0;
}
```

The output is-

(a) 5
(b) 11
(c) Garbage value
(d) Compilation Error

[NAT]

13. Consider the following program:

```
#include <stdio.h>
int main()
{
```

```
int a[2][2][3]={0,1,2,3,4,5,6,7,8,9,10,11};
printf("%d", *(*(*a+1)+1)+1);
printf("%d", a[1][1][1]);
printf("%d", ***(a+1));
printf("%d", **(*a+1));
printf("%d", *(**a+1));
    return 0;
}
```

The sum of printed values is ___________

Answer Key

1. (c)
2. (a, d)
3. (c)
4. (18)
5. (b)
6. (a)
7. (d)
8. (c)
9. (a)
10. (b)
11. (8)
12. (a)
13. (25)

Hints and Solutions

1. **(c)**
P: int a[2]={5,10};//It is valid declaration.
printf("%d", 1[a]);//1[a] is equivalent to a[1].
Hence, P is correct.

Q: int 2[a]={5,10};//It is invalid declaration.
printf("%d", 1[a]);
Hence, Q is incorrect.

2. **(a, d)**

int b[][]={1,2,3,4};//Not allowed

int b[][2][2]={1};//allowed

int b[]={1};//allowed

int b[][3];//Not allowed

3. **(c)**
a denotes the base address of the 0^{th} 1D array.
**a denotes the 0^{th} element of the 0^{th} 1D array.
((a+**a+1)+2)+3=*(*(a+1+1)+2)+3=*(*(a+2)+2)+3
a+2 points to the 2^{nd} 1D array. *(a+2) points to the 0^{th} element of the 2^{nd} 1D array.
(*(a+2)+2) points to the 2^{nd} element of the 2^{nd} 1D array.

((a+2)+2) is the 2^{nd} element of the 2^{nd} 1D array. So, *(*(a+2)+2)=11

((a+2)+2)+3=11+3=14.
Output: 14

4. **(18)**
b points to the 4^{th} element of a i.e 9.
For i=0:
count=count+(*b---i);//post decrement is evaluated before *.

count=0+(9-0)=9;//b is decremented to a+3; b now points to 7.
For i=1:
count=count+(*b---i);//post decrement is evaluated before *.

count=9+(7-1)=15;//b is decremented to a+2; b now points to 5.

For i=2:
count=count+(*b---i);//post decrement is evaluated before *.

count=15+(5-2)=18;//b is decremented to a+1; b now points to 3.

Final value of count=18.

5. **(b)**
ptr+=sizeof(2*a[0]);
a[0] is 1. So, ptr+=sizeof(2);

Now 2 is an integer.So, ptr+=4; ptr points to 5. *(ptr-2)=3 is printed.

6. **(a)**

P: INCORRECT. NULL pointer dereferencing is not allowed.

Q: INCORRECT. p is an uninitialized pointer.

7. **(d)**

100	102	104
3	~~2~~ 3	1

	200
p	~~100~~ 102

For i=0:
*p=3;
For i=1:
*(p+1)=3-1=2;
For i=2:
*(p+2)=3-2=1;
q=100;

printf("%u\t",*++p);//*102 i.e 2 is printed.

printf("%u\t", ++*p);// ++*102 i.e 3 is printed

printf("%u\t", p-q); //(102-100)/2 i.e 1 is printed.

Output: 2 3 1

8. (c)

```
        main()
p [ 100 ] q [ 200 ] k [ 97 ] b [ C ]
                     100       200
printf("%d", *(char*)p-*(char *)q);
// 97-67=30
```

9. (a)

ptr is a pointer the function func().
func(a, 5):
p stores the starting address or the address of the 0^{th} element of the array. p=a, n=5;
For i=1:
sum=sum+*(p+1)+*p++;//Post decrement operator will be evaluated before *.
sum=2+1+7;//p then points to 1.
sum=10;
For i=2:
sum=sum+*(p+2)+*p++;//Post decrement operator will be evaluated before *.
sum=10+5+1;//p then points to 3.
sum=16;
Output: 16

10. (b)

P and R returns the address of local variable. So, P and R are invalid.
Q returns the address of static variable. It is allowed.

11. (8)

func(a+2):
p stores the address of a[2].
++*p++;a[2] is incremented by 1.a[2]=4. p now points to a[3].
++*++p; p now points to a[4]. a[4] is incremented by 1.a[4]=2.

a[2]+a[3]+a[4]=4+2+2=8.

12. (a)

f(a, 3):
ptr is the pointer to the elements of a[0].
f(a+1, 2) is called.
f(a, 3) returns 4+a=4+1=5 to main().**

f(a+1, 2):
ptr is a pointer to the elements of a[1].
f(a+2, 1) is called. It returns 0.
f(a+1, 2) returns 0+(a+1) i.e. 0+4=4 to f(a, 3).**

13. (25)

((*a+1)+1) is the 1^{st} element in the 1^{st} 1D array of the 0^{th} 2D array.
((*a+1)+1)+1=4+1=5
a[1][1][1] is the 1^{st} element in the 1^{st} 1D array of the 1^{st} 2D array i.e 10
***(a+1) is the 0^{th} element in the 0^{th} 1D array of the 1^{st} 2D array i.e 6

**(*a+1) is the 0^{th} element in the 1^{st} 1D array of the 0^{th} 2D array i.e 3

*(**a+1) is the 1^{st} element in the 0^{th} 1D array of the 0^{th} 2D array i.e 1

Output: 5 10 6 3 1
Sum: 25

Branch : CSE & IT **Batch: (Hinglish)**

WEEKLY TEST – 01

Subject : Compiler Design

Topic : Lexical Analysis & Syntax Analysis

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. What is the input to the first phase of compiler?

(a) Token stream (b) Character stream

(c) Syntax tree (d) None of these.

[MSQ]

2. Select the functionality of lexical analyzer

(a) Lexical analyzer produces syntax error and line number.

(b) It matches the longest prefix of the identifier.

(c) It recognizes tokens and produces a stream of lexeme.

(d) It recognizes white space, comments, and ignore them.

[NAT]

3. Consider the following program:

```
int main ()
{
    printf("%d + %d = %d", 5, 2, 7); /*sum*/
    return 0;
}
```

How many numbers of tokens are there in program after preprocessing?

[MCQ]

4. Match the following phases of the compiler in List I with the input required in List II.

List I	List II
(a) Lexical analyzer	(i) Token stream
(b) Syntax analyzer	(ii) Intermediate representation.
(c) Semantic analyzer	(iii) Character stream
(d) Code generator	(iv) Syntax tree.

(a) 1 – (i); 2 – (ii); 3 – (iv); 4 – (iii)

(b) 1 – (iii); 2 – (i); 3 – (ii); 4 – (iv)

(c) 1 – (i); 2 – (ii); 3 – (iii); 4 – (iv)

(d) 1 – (iii); 2 – (i); 3 – (iv); 4 – (ii)

[MCQ]

5. Calculate the token in the following C program using lexical analyzer.

```
int main ()
{
    int a, * b;
    a = 20;
    b = & a;
    printf("%d%d", a, * b);
}
```

(a) 28 (b) 31

(c) 34 (d) 30

Q.6 to 10 Carry ONE Mark Each

[MCQ]

6. Which of the following is lexical error.

(a) 123gate (b) gate123

(c) gate_123 (d) None of these

[MCQ]

7. ______derivation used by top-down parser while parsing any input string.

(a) Leftmost derivation

(b) Rightmost derivation

(c) Leftmost derivation in reverse.

(d) Rightmost derivation in reverse.

[MCQ]

8. Which of the following are present in FIRST(S) ∩ FIRST(F)?

$S \rightarrow E$

$E \rightarrow Ff \mid Gh$

$F \rightarrow ef \mid Gh \mid \epsilon$

$G \rightarrow Gg \mid \epsilon$

(a) {e, f, g, h} (b) {e, f, h, ∈}

(c) {e, g, h, ∈} (d) {e, g, h}

[MCQ]

9. Which of the following is valid set of FIRST (E) U FOLLOW (B)

$S \rightarrow aBDh$

$B \rightarrow cC$

$C \rightarrow bC / \epsilon$

$D \rightarrow EF$

$E \rightarrow g / \epsilon$

$F \rightarrow f / \epsilon$

(a) {g, f, h, ∈} (b) {a, g, f}

(c) {b, g, h} (d) None of these

[NAT]

10. How many terminals are there in FIRST(A) for the following grammar?

$A \rightarrow BC \mid a$

$B \rightarrow Cb \mid dB \mid \varepsilon$

$C \rightarrow aA \mid g$

Answer Key

1. **(b)**
2. **(b,c,d)**
3. **(20)**
4. **(d)**
5. **(b)**
6. **(a)**
7. **(a)**
8. **(d)**
9. **(a)**
10. **(3)**

Hints and Solutions

1. **(b)**

First phase of complier is lexical analyzer. Input to lexical analyzer is character stream and output of lexical analyzer is token stream.

2. **(b, c, d)**

(a) Lexical analyzer produces lexical error corresponding line number. So option A is incorrect.
(b) It makes the longest prefer of the identifier. Correct.
(c) Lexical analyzer recognizer lexemes and produces a stream of tokens. So option C is Incorrect.
(d) It recognizes white space, comments, and ignore them correct.

3. **(20)**

After preprocessing program will be:

int	main	(	)
1	2	3	4

{
5

printf	("	% d + % d =%d"	,	5	,	2	,	
6	7	8	9	10	11	12	13	

7	)	;
14	15	16

return	0	;
17	18	19

}
20

So, total 20 tokens are there after preprocessing.

4. **(d)**

Lexical analyzer takes character stream as input. Syntax analyzer takes token stream as input. Semantic analyzer takes stream as input. Semantic analyzer takes syntax tree as input. Code generator takes intermediate representation as input.

5. **(b)**

Given program:

int	main	(	)
1	2	3	4

{
5

int	a	,	*	b	;
6	7	8	9	10	11

a	=	20	;
12	13	14	15

b	=	&	*a*	;
16	17	18	19	20

printf	("	%d%d"	,	a	,	*	b	)	;
21	22	23	24	25	26	27	28	29	30

}
31

6. **(a)**

123gate is not a valid token, therefore it will give lexical error.

7. **(a)**

Top down parser uses leftmost derivation while parsing any input string.

8. **(d)**

Solution- **({e, g, h})**

First of all non-terminals.

S	{e, f, g, h}
E	{e, f, g, h}
F	{e, g, h, ∈}
G	{g, ∈}

So, FIRST(S) ∩ FIRST (F) = {e, f, g, h} ∩ {e, g, h, ∈}

= {e, g, h}

9. (a)

First(E)= {g, ∈}

Follow (B) = {First(D)- ∈} U {h} = {g, f, h}

So, First(E) U Follow(B) = {g, f, h, ∈}

So, option a is correct.

10. (3)

FIRST(A) = FIRST(BC) ∪{a}

= {a, g, d} ∪ {a}

= {a, g, d}

So, 3 terminals are present in FIRST(a).

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 02
Subject : Compiler Design
Topic : Lexical Analysis & Syntax Analysis

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[NAT]

1. Consider G be a grammar with the following productions:

$A \to A + B \mid B$

$B \to B * C \mid C$

$C \to (A)$

$C \to id$

Let, X is set of lookaheads in A→. B and Y is set of lookaheads in C→ .id. Then how many numbers of items are present in $X \cap Y$ if LR (1) parser is used?

[MSQ]

2. Which of the following statement is/are correct?
(a) LALR parser is more powerful the SLR parser.
(b) SLR parser is more powerful the CLR parser.
(c) LR (0) is the least powerful parser.
(d) CLR is powerful that LALR and LR(0) parser.

[MSQ]

3. Which of the following is/are incorrect.
(a) Every regular grammar is LL(1).
(b) If given grammar G is LL(1) then it is LR(0).
(c) Let SLR(1) has x_1 states and CLR(1) has x_2 states then the relation between x_1 and x_2 is $x_1 < x_2$.
(d) Recursive descent parser is a top - down parser.

[MCQ]

4. Consider the given grammar

X→ a | ab|abc

The given grammar is_______.
(a) LL(1) (b) LL(2)
(c) LL(3) (d) None of these

[NAT]

5. Consider the following grammar.

$S' \to S$

$S' \to S*A \mid A$

$A \to A+B \mid B$

$B \to B– C \mid C$

$C \to (S) \mid id$

If I_0 is the set of LR(0) items {[S'→S·] [S→S·*A]}, then goto (closure (I_0, *) contains exactly___items.

Q.6 to 10 Carry TWO Mark Each

[NAT]

6. Consider the given grammar.

$S \rightarrow A$

$A \rightarrow ABC \mid BC$

$B \rightarrow Cc \mid b \mid \in$

$C \rightarrow \in$

How many number of unique production are in goto $(A \rightarrow A \cdot BC) \cup$ goto $(A \rightarrow \cdot BC)$

[MCQ]

7. Consider the following grammars.

G_1: $S \rightarrow aSbS \mid bSaS \mid \in$

G_2: $S \rightarrow aABa$

$A \rightarrow c \mid \in$

$B \rightarrow d \mid \in$

Which of the following is correct?

(a) Only G_1 is LL(1).
(b) Only G_2 is LL(1).
(c) Both G_1 and G_2 are LL(1).
(d) Neither of G_1 and G_2 are LL(1).

[MCQ]

8. Consider the following grammar.

$S \rightarrow$ (A | B] | B)

$A \rightarrow$ B) | B]

$B \rightarrow \in$

Which of the following is correct statement if CLR(1) parser is used ?

(a) The given grammar has RR conflict but no SR conflicts.
(b) The given grammar has RR conflict but no RR conflicts.
(c) The given grammar has RR and SR conflicts.
(d) The given grammar do not have RR and SR conflicts.

[MSQ]

9. Which of the following statement is/are correct about given language?

$L = \{a^l b^m c^n \mid l = m \text{ or } m = n, l, m, n > 0\}$

(a) The language is not LR(0).
(b) The language is ambiguous.
(c) The language is not LR(k) for any k.
(d) The language recognizes by DPDA (Deterministic Pushdown Automata.)

[MCQ]

10. Consider the given grammar.

$S \rightarrow AaB \mid aA$

$A \rightarrow bB \mid B$

$B \rightarrow aB \mid a$

If S, A, B are non-terminals and a, b are terminals.

The above grammar is?

(a) LALR(1) but not SLR(1)
(b) CLR(1) but not LALR(1)
(c) CLR(1) and LALR(1)
(d) Neither CLR (1) nor LALR(1)

Answer Key

1.	**(3)**	**5.**	**(7)**	**9.**	**(a,b,c)**
2.	**(a,c,d)**	**6.**	**(4)**	**10.**	**(d)**
3.	**(a,b,c)**	**7.**	**(b)**		
4.	**(c)**	**8.**	**(d)**		

Hints and Solutions

1. (3)

A' $\rightarrow$ .A, {$}

A $\rightarrow$ ·A + B {$, +}

A $\rightarrow$ ·B{$, +} …….$\rightarrow$[A$\rightarrow$ ·B]

B $\rightarrow$ ·B*C, {$, *}

B $\rightarrow$ ·C, {$, *}

C $\rightarrow$ ·(A), {$, *}

C $\rightarrow$ ·id, {$, *}$\rightarrow$[C$\rightarrow$ id]

From A'$\rightarrow$ A, {$} and A$\rightarrow$ ·A+B, A's production will have look aheads as {$, +}

From A$\rightarrow$·B, {$,+} and B$\rightarrow$ B*C, B's procution will have look ahead as {$, +,*}.

B $\rightarrow$ ·C, {$, *,+} C's production will have lookahed as {$,+,*}

So, total 3 different lookahead are there.

2. (a, c, d)

CLR > LALR > SLR > LR(0)

So, CLR is the most powerful parser and LR(0) is the least powerful parser.

LALR is more powerful then SLF parser. (True)

SLR is more powerful then CLF parser. (False)

LR(0) is the least powerful parser. (True)

CLR is powerful than LALR and LR(0) parser. (True)

3. (a,b,c)

Every regular grammar is LL(1), this statement is incorrect regular grammar can be ambigrous and ambigous grammar cannot be LL(1).

If a grammar is LL(1) then it must be CLR(1) but it may or many not be LR(0). Hence given statement is incorrect.

If SLR(1) has x_1 states and CLR(1) has x_2 states then the relation between x_1 and x_2 is $x_1 \leq x_2$. So incorrect.

Recursive descent parser is a top down parser. Correct.

So, option (a,b,c) are answer.

4. (c)

Given grammar

$x \rightarrow$ a | ab | abc

For LL(1)

First (a) $\cap$ First (ab) = a {this is not empty}

So, the grammar is not LL(1).

For LL(2).

Second (ab) $\cap$ second (abc) = {this is not empty}

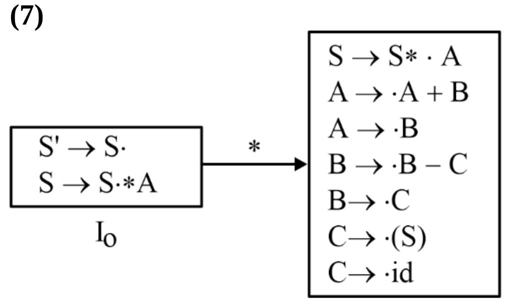
So, the grammar is not LL(2).

For LL(3).

Third (ab) $\cap$ Third (abc) = {empty}

So, the given grammar is LL(3).

5. (7)



So, goto (closure (I_o),*) contains exactly 7 States.

6. (4)

Augumented grammar is as follows:

S' $\rightarrow$ S

S $\rightarrow$ ·A

A $\rightarrow$ ·ABC

A$\rightarrow$ ·BC

B $\rightarrow$ ·Cc

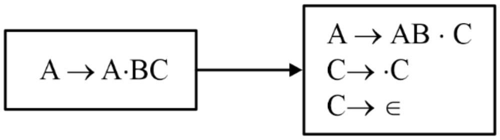
B $\rightarrow$ ·b

B $\rightarrow$ $\in$

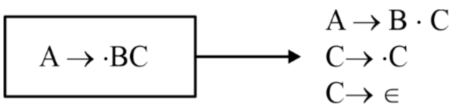
C $\rightarrow$ ·C

C $\rightarrow$ $\in$

For, A $\rightarrow$ A·BC



For, A $\rightarrow$ ·BC



Goto (A→A· BC) ∪ goto (A→· BC)

{A→AB.C, C→·C, C→∈}∪{A→B·C, C→ ·C, C→∈}

{A→AB·C, A→B·C, C→·C, C→∈}

Total 4 production.

7. (b)

G_1:

Frist (S) = {a,b,∈}

Follow (S) = {a,b,$}

	a	B	$
S	S→aSbS S→∈	S→bSaS S→∈	S→∈

This is not LL(1).

G_2:

Frist (S) = {a}

Frist (A) = {c,∈}

Frist (B) = {d,∈}

Follow (S) = {$}

Follow (A) = {d,b}

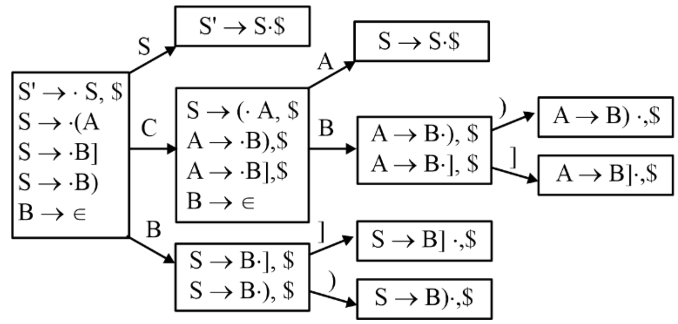
Follow (B) = {b}

	a	b	c	d	$
S	S→aABb				
A		A→∈	A→C	A→∈	
B		B→∈		B→d	

This is LL(1).

So, option (b) is corret.

8. (d)



The given garmmar do not have any RR conflict and SR conflict. Therefore, option (d) is correct.

9. (a,b,c)

L ={$a^l b^m c^n$| l = m or m = n } generates non-determinstic context free language.

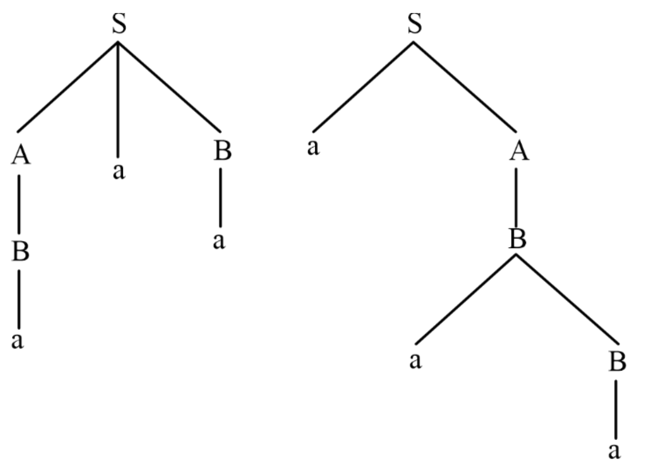
So, it cannot abe recongnized using DPDA.

The grammar can generate ambiguous grammar. So when grammar can be ambigous it cannot generate LL(k) or LR(k) grammar.

Therefore, option (a,b,c) are correct.

10. (d)

The given grammar is ambiguous grammar. For string aaa, we have multiple parse tree.



So, the grammar is not SLR(1), not CLR(1), and also not LALR(1).

Hence, Option (d) is correct.

Branch : CSE/IT **Batch : Hinglish**

WEEKLY TEST – 03

Subject : Compiler Design

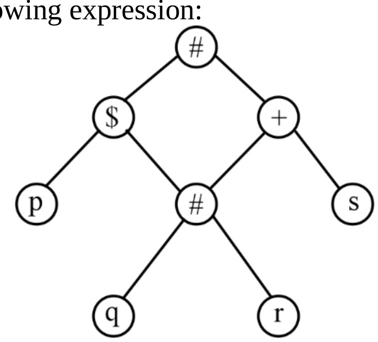
Topic : Syntax Directed Translation and Intermediate Code & Code Optimization

Maximum Marks 10

Q.1 to 3 Carry ONE Mark Each

[MCQ]

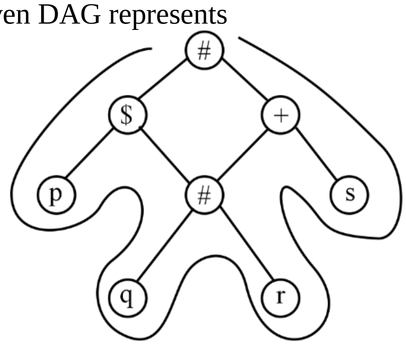
1. The DAG (directed acyclic graph) represents which of the following expression:



(a) p $ (q # r) + s (b) p $ q # r # q # r + s
(c) (p $ q) # (r + s) (d) (p $ (q # r)) # ((q # r) + s)

Ans.(d)

The given DAG represents



(p $ (q # r)) # ((q # r) + s)
So, option (d) is correct answer.

[MSQ]

2. Three address codes can be implemented using
(a) Quadruples (b) Direct quadruples
(c) Triples (d) Indirect triples

Ans.(a, c, d)

There are three implementations used for three address code statements which are as follows:
→ Quadruples
→ Triples
→ Indirect triples
So, a, c, d are correct answer.

[MCQ]

3. A synthesized attribute is an attribute whose value at a parse tree node depends on.
(a) Attribute at parent node only
(b) Attribute at children node only
(c) Attribute at siblings only
(d) None of these

Ans. (b)

An attribute is said to be synthesized attribute if its parse tree value is determined by the attribute value at child nodes.

[MSQ]

4. Which of the following is/are an intermediate representation of the source program in compilers?
(a) Three address code
(b) Directed Acyclic Graph (DAG)
(c) Control Flow Graph (CFG)
(d) Symbol table

Ans.(a, b, c)

In the context of compilers, symbol table is not an intermediate representation of the source program. Symbol table is a table used to store attributes information and it is used in all the phases of compilers. Three address code, AST, Control Flow Graph, and DAG are intermediate representations.

[MCQ]

5. Which of the following is not performed during compilation?
(a) Dynamic memory allocation
(b) Type checking
(c) Symbol table management
(d) None of these

Ans.(a)

Dynamic memory allocation is performed during runtime. Type checking is performed during semantic analysis. Symbol table management, it

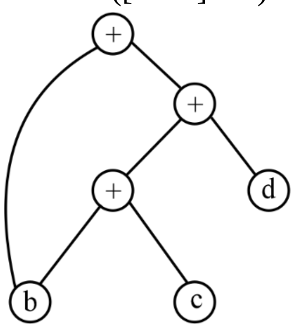
stores and retrieve the information of token during compilation.
So, (a) is correct answer.

[MCQ]

6. Consider the basic block given below:
a = b + c
c = a + d
d = b + c
e = d – b
a = e + b
The minimum number of nodes and edges present in the DAG representation of the above basic block respectively are:
(a) 6 and 6 (b) 4 and 4
(c) 8 and 10 (d) 9 and 12

Ans. (a)

a = e + b
= (d – b) + b
= ([b + c] –b) + b
= ([b + (a + d)] – b) + b
= ([b + (b + c)+ d] – b) + b
A = b + ([b + c] + d)



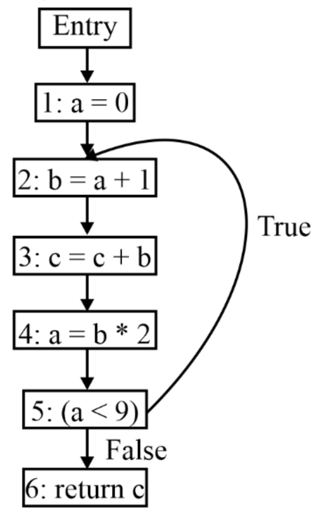
There are total 6 nodes and 6 edges, So, option (a) is correct.

[MCQ]

7. Consider the following psedo code;
1 : a = 0
2 : b = a + 1
3 : c = c + b
4 : a = b * 2
5 : if (a < a) goto 2
6 : return c
Which of the following is correct live range for variable b?
(a) 2 → 3 → 4 → 5 (b) 1 → 2 → 3 →4
(c) 3 →4 →5 → 2 (d) 2 → 3 → 4

Ans.(d)

- The directed graph for given pseudo code:
  b is used in statement 4, so b is live on the 3 → 4 edges.
- Since statements 3 does not define b, b is also live on the 2 → 3 edges.
- Statement 2 define b, so any value of b on the 1 → 2 and 5 → 2 edges are not needed, so b is dead along these edges.
- b live range is 2 → 3 → 4



[NAT]

8. Consider the following three-addresses code.

$t_1 = a + b$
$t_2 = c + d$
$t_3 = t_1 * t_2$
$t_4 = t_2 + t_2$
$t_5 = t_4 + t_3$

What will be the minimum number of temporary variable in equivalent optimized three-address code of above code?

Ans.(2)

Sol. The equivalent optimized three-address code will be:

$t_1 = a + b$
$t_2 = c + d$
$t_1 = t_1 * t2$
$t_2 = t_2 + t_2$
$t_1 = t_1 + t_2$

The above code represents the following expression ((a + b) * (c + d)) + ((c + d) + (c +d)) only two variables are required.

[MCQ]

9. Consider the following SDT.

E → XY {Y·a = X·a}

E → XUVY {V·a = X· a + V· a}

Y → 4 {Y·a = 4}

V → ∈ {V · a = 0

U → ∈ {U · a = 0}

X → ∈ {X · a = 0}

The given SDT is

(a) Only L-attributed

(b) Only S-attributed

(c) Both L and S-attributed

(d) None of these

Ans.(a)

The given SDT is L-attributed (i.e. restricted inherited attributes and synthesized attributes).

Y·a = X·a is computed using left sibling

So, it is not S-attributed.

[MCQ]

10. A shift reduce parser performs actions specified with in braces immediately after reducing the corresponding rule of grammar.

A → bbB {print "+"}

A → a {print "*"}

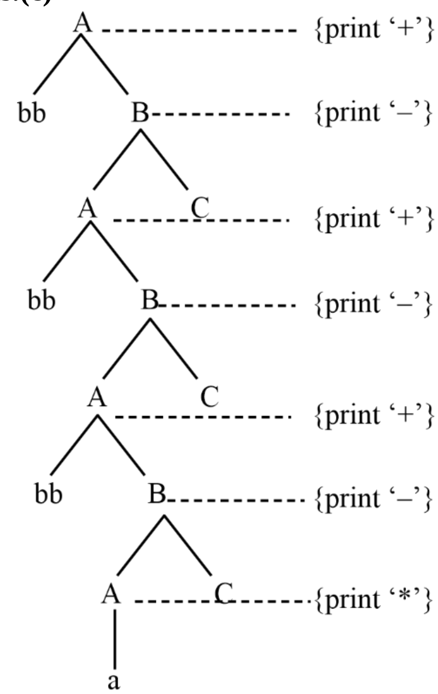
B → Ac {print "–"}

What will be the translation of bbbbbbaccc using the given SDT scheme?

(a) + – + – + – * (b) + – + * – + –

(c) *– + – + – + (d) – + – * – + – 1

Ans.(c)



So, the above tree prints * – + – + – +

Answer Key

1. (d)
2. (a, c, d)
3. (c)
4. (a, c, d)
5. (a)
6. (a)
7. (d)
8. (2)
9. (a)
10. (c)

Branch : CSE & IT — Batch:Hinglish

WEEKLY TEST – 01

Subject : Computer Networks

Topic : Types of Communication and Classful Addressing

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. Consider an IP address 150.0.94.31 what will be the Network ID for given IP?

(a) 150.0.94.0

(b) 150.0.0.0

(c) 150. 0.255.25

(d) Both (a) and (b)

[MCQ]

2. Which of the following IP address can be used for SIP address as well as destination IP address?

(a) 200.200.254.255

(b) 255.255.255.255

(c) 200.208.0.100

(d) Both (a) and (b)

[MCQ]

3. Which of the following is possible number of network and hosts in each network under class B address in IPV_4 addressing format respectively?

(a) 2^{16}, 2^{16}

(b) 2^{16}, 2^{16-2}

(c) 2^{14}, $2^{16}-2$

(d) 2^{14}, 2^{16}

[MSQ]

4. Which of the following address can be used for inter process communication in a host?

(a) 0.0.0.0

(b) 127.0.100.5

(c) 127.10.15.127

(d) 127.127.127.127

[MCQ]

5. Identify the type of the IP address 192.192.192.255 (Assuming classful addressing scheme followed).

(a) Directed broadcast address

(b) Limited broadcast address

(c) Host IP address

(d) Network address

Q.6 to 10 Carry TWO Mark Each

[MCQ]

6. Consider an IP address 23. 108.157.24. How many bits are allocated for HID (Assuming classful addressing is used)?

(a) 8

(b) 16

(c) 24

(d) 32

[MCQ]

7. What percentage is occupied by class C IP addresses?

(a) 50%

(b) 25%

(c) 12.5%

(d) 6.25%

[MCQ]

8. How many networks are present in class C?

(a) 2^{30} (b) 2^{21}

(c) 2^{8} (d) 2^{29}

[MCQ]

9. Which of the following is false about networks and hosts (Assume classful addressing is used)?

(a) Class A networks 2^7 and hosts $2^{24} – 2$

(b) Class B networks 2^{14} and hosts $2^{16} – 2$

(c) Class C networks 2^{21} and hosts 254

(d) Class A networks $2^7–2$ and hosts $2^{24} – 2$

[MCQ]

10. Consider an IP address 128.16.16.10 belong to which class?

(a) class A

(b) class B

(c) class C

(d) class D

Answer Key

1. (b)
2. (c)
3. (d)
4. (b, c, d)
5. (a)
6. (c)
7. (c)
8. (b)
9. (a)
10. (b)

Hints and Solutions

1. (b)

IP address = 150.0.94.31 [Class B]

Network mask = 255.255.0.0

Network ID = 150.0.94.31

And

255.255.0.0

150.0.0.0

2. (c)

(a) 200.200.254.255 is a DBA of Network

(b) 255.255.255.255 is a LBA of Network

- LBA cannot be used as SIP
- DBA cannot be used as SIP
- 200.200.0.100 we can use SIP as well as DIP

3. (d)

NID	NID
10 ___	
16	16

Number of networks = $2^{16-2} = 2^{14}$

Number of IP Addresses = 2^{16}

Hence, option (d) is correct.

4. (b, c, d)

- 127.x.y.z is used for inter process communication or self-connectivity.

Hence, option (b, c, d) are correct.

5. (a)

IP address 192.192.192.255 belongs to class C

192.192.192 . 255

↓ ↓

NID HID

All 1's in HID, so it's direct broadcast address.

Hence option (a) is correct.

6. (c)

23.108.157.24 is belong to class A.

In class A

NID = 8 bits

HID = 24 bits

Hence, option (c) is correct.

7. (c)

Suppose total IP address are 2^{32}

For class A = 2^{31} = 50%

For class B = 2^{30} = 25%

For class C = 2^{29} = 12.5%

Hence, option (c) is correct.

8. (b)

In class C first 3 bits are fixed (110)

NID = 24 bits

HID = 8 bits

So total number of networks in class C = 2^{24-3}

So total number of networks in class C = 2^{21}

Hence, option (b) is correct.

9. (a)

In class A number of networks are 1 to 126 because we do not consider 0.0.0.0 and 127.x.y.z. So number of networks in class A = $2^7 - 2$ and number of hosts are $2^{24} - 2$. So option (a) is false.

10. (b)

128.16.16.10 belong to class B

Class B range = 128 to 191

Hence, option (b) is correct.

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 02

Subject : Computer Networks

Topic : Subnetting

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. Consider a class C network 203.219.230.19 and subnet mask 255.255.255.128 which of the following is possible DBA for first subnet?

SID	Subnet number
0	2nd Subnet
1	First Subnet

(a) 203.219.230.255

(b) 203.219.230.127

(c) 203.219.230.0

(d) 203.217.230.128

[NAT]

2. Suppose, a class B network with subnet mask 255.255.224.0 the number of hosts per subnet is ___.

[NAT]

3. Consider an IP address of block is 196.197.198.78 and subnet mask 255.255.255.240. The subnet number for given IP address is _______.

[MCQ]

4. Consider an IP address in a block is 149.160.170.15 and subnet mask is 255.255.224.0. After finding subnet ID, what is the first host?

(a) 149.160.161.0

(b) 149.160.161.1

(c) 149.160.160.1

(d) 149.160.170.1

[MCQ]

5. A subneted class C network has the following broadcast address 203.205.196.159. Which of the following is possible subnet mask is for given DBA?

(a) 255.255.255.128

(b) 255.255.255.224

(c) 255.255.255.192

(d) Both (b) and (c)

Q.6 to 10 Carry TWO Mark Each

[NAT]

6. Classless inter-domain routing (CIDR) receives a packet with the address 139.46.38.98. The router's routing table has the following entries:

Prefix	Output Interface
139.30.0.0/12	1
139.32.0.0/11	2
139.44.0.0/14	3
Default	4

The identifier of the output interface on which this packet will be forwarded is ____.

[MCQ]

7. Consider an IP address in a block is 120. 126.212.59 and subnet mask is 255.240.0.0. To represent the 3rd subnet, SID bits are 0110 then, what is the last host of 3rd subnet?

(a) 120.32.255.254 (b) 120.116.255.254

(c) 120.111.255.254 (d) None of these

[NAT]

8. Consider the following configuration given below:

Host A	180.169.68.15
Router R_1	180.169.147.13 and 180.169.153.29
Router R_2	180.169.81.14 and 180.169.99.77
Host D	180.169.81.88

Suppose, Host A is connected through two router R_1 and R_2 to another host D with given IP addresses. The netmask is used in the network is 255.255.240.0. How many total distinct subnets are guaranteed to already exist in the network? ______

[MCQ]

9. Consider an IP address in a block is 21.69.28.26 and subnet mask contain 10 ones continuously then what is the DBA of last subnet?

(a) 255.255.225.255

(b) 21.255.255.255

(c) 21.127.255.255

(d) None of these

[NAT]

10. Consider an IP address in a block is 200. 200. 250.113 and subnet mask is 255.255.255.224. if subnet ID of IP address is X.Y.Z.P and subnet number is Q. Then, the value of $\frac{P}{Q}$ is ______.

Answer Key

1. (a)
2. (8190)
3. (5)
4. (c)
5. (b)
6. (3)
7. (c)
8. (4)
9. (b)
10. (24)

Hints and Solutions

1. (a)

SM = 255.255.255.10000000

SID

Network = 203.219.230.19

First Subnet ID = 203.219.230.128

DBA for 1st subnet = 203.219.230.255

Hence option (a) is correct.

2. (8190)

Class B =

NID	HID
16 bits	16 bits

Subnet mask = 255.255.224.0

= 11111111.11111111.11100000.00000000

Number of subnet bits

= number of 1's in subnet mask – NID bits

= 21 – 16 = 5

Number of hosts = Number of 0's in subnet mask

= 13

Number of hosts = $2^{13} - 2$

= 8 * 1024 – 2

= 8192 – 2 = 8190

3. (5)

SID = 196.197.198.78

255.255.255.240

196.197.198.64

SID bits = 4

SID = 196.197.198.01000000

Subnet number = 0100

= 4 + 1

= 5

4. (c)

IP address = 149.160.170.15

Subnet mask = 255.255.224.0

SID = 149.160.160.0

First host = 149.160.160.1

Hence, option (c) is correct.

5. (b)

DBA = 203.205.196.10011111

HID bits

HID bits ≤ 5

(a) 255.255.255.10000000

HID bits = 7 **(invalid)**

(b) 255.255.255.11100000

HID bits = 5 **(valid)**

(c) 255.255.255.11000000

HID bits = 6 **(invalid)**

Hence option (b) is correct.

6. (3)

For interface – 1:

SM = 11111111.11110000.00000000.00000000

= 255.240.0.0

139.46.38.98

255.240.0.0

139.32.0.0

(Not Matched)

Router will not forward this packet to interface – 1.

For – interface – 2:

SM = 11111111.11100000.00000000.00000000

= 255.224.0.0

139.46.38.98

255.224.0.0

139.32.0.0

(Matched)

Router will forward this packet to interface – 2

For interface – 3:

SM = 255.252.0.0

= 139.46.38.98

255.224.0.0

139.44.0.0 (Matched)

Router will forward this packet to interface – 3.

If more than 1 interface matched then router will forward the packet to longest subnet mask.

Hence, (3) is correct.

7. (c)

IP = 120.126.212.59

SM = 255.240.0.0

SID = 120.112.0.0

3rd subnet bits = 0110

3rd SID = 120.01100000.00000000.00000000

= 120.96.0.0

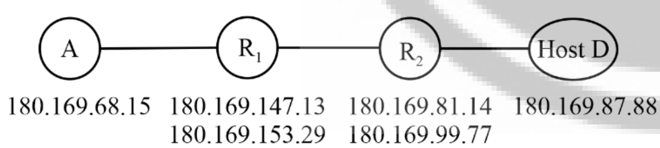
Last host of 3rd Subnet

= 120.01101111.11111111.11111111

= 120.111.255.254

Hence, option (c) is correct.

8. (4)



Netmask = 255.255.240.0

= 1111111.11111111.<u>1111</u>0000.00000000

Find the SID of each IP address if first 4 bits of 3rd octet are same then they belong to same subnet.

Host A SID = 180.169.68.15

255.255.240.0

180.169.64.0

- Router R_1 SID with IP address 180.169.147.13.

  SID = 180.169.144.0
- Router R_1 SID with IP address 180.169.153.29

  SID = 180.169.144.0
- Router R_2 SID with IP address 180.169.81.14

  SID = 180.169.80.0
- Router R_2 SID with IP address 180.169.99.77

  SID = 180.169.96.0
- Host D SID with IP address 180.169.87.88

  SID = 180.169.87.88

  255.255.240.0

  180.169.80.0

Total different SID are 4.

9. (b)

IP = 21.69.28.26

SM = 11111111.11000000.00000000.00000000

= 255.192.0.0

SID of last host = 21.192.0.0

DBA of last host = 21.255.255.255

Hence, option (b) is correct.

10. (24)

SID = 200.200.250.113

255.255.255.224

200.200.200.96

P = 96

SID = 200.200.200.<u>011</u>00000

Subnet number (Q) = 011

= 3 + 1

= 4

$$\frac{P}{Q} = \frac{96}{4} = 24$$

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 03

Subject : Computer Networks

Topic : Classless Addressing and Supernetting

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[NAT]

1. How many networks can be joined with class C supernet mask 255.248.0.0?

[NAT]

2. Suppose, IP address of the block is 200.196.78.79 and subnet mask contain 29 ones in the network. Then the subnet number will be ________.

[MCQ]

3. A block contains 512 IP addresses. Which of the following can be first address of the block to assign any host?

(a) 118.17.15.0 (b) 118.17.14.0

(c) 118.17.14.15 (d) 118.17.14.1

[MCQ]

4. How many maximum networks can be combined with supernet mask 255.252.0.0?

(a) 4 (b) 512

(c) 1024 (d) None of these

[MCQ]

5. A company needs 720 addresses which of the following supernet mask is possible if it is for class C address?

(a) 255.255.0.0

(b) 255.252.0.0

(c) 255.255.255.255

(d) None of these

Q.6 to 10 Carry TWO Mark Each

[NAT]

6. Suppose a class B network is divided into 4096 subnets. How many subnets are possible if we use variable length subnet mask? _______

[MCQ]

7. Suppose IP address of the block is 69.169.9.74 and subnet mask is 255.252.0.0. What is the 186th host of 11th subnet?

(a) 0100101.00101100.10111010.00000000

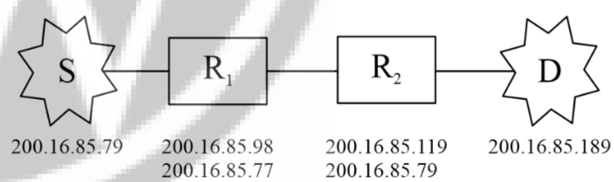
(b) 01000101.00101100.00000000.10111010

(c) 01000101.00101000.00000000.10111010

(d) None of these

[MCQ]

8. Consider the following scenario given below:



In above scenario sources 'S' is connected to destination 'D' through two routers R_1 and R_2. Suppose, the netmask is used in the network is 255.255.255.224. Which subnet number and how many subnets is /are same subnets are guaranteed to already exist in the network with respect to source 'S'?

(a) 3 and 2 (b) 4 and 3

(c) 2 and 3 (d) 3 and 3

[MCQ]

9. Consider two systems S_1 and S_2 with their IP address and subnet mask are given below:

System	IP address	Subnet mask
S_1	212.128.17.58	11111111.11111111 .11111111.11110000
S_1	212.128.17.33	11111111.11111111 .11111111.11000000

Which of the following is correct for above given two systems?

(a) S_1 and S_2 both assume they are on the same network.

(b) S_1 assume S_2 is on same network, but S_2 assume S_1 is on a different network.

(c) S_2 assume S_1 is on same network, but S_1 assume S_2 is on a different network.

(d) None of these

[MSQ]

10. Which of the following is/are valid Direct Broadcast Address (DBA) for subnet mask 255.255.240.0?

(a) 180.64.248.255

(b) 180.64.63.255

(c) 180.64.127.255

(d) 180.64.255.255

Answer Key

1. (2048)
2. (10)
3. (d)
4. (c)
5. (b)
6. (1820)
7. (c)
8. (a)
9. (c)
10. (b, c, d)

Hints and Solutions

1. (2048)

Supernet mask = 255.248.0.0

NID = 13

NID in class C = 24

Number of bits for network that can be joined = 11

Number of networks = 2^{11}

= 2 * 1024

= 2048

2. (10)

IP address = 200.196.78.01001111

Subnet mask

$= 11111111.1111111.11111111.\underbrace{11111}_{\text{SID}}\,\underbrace{000}_{\text{HID}}$

NID = 24 bit (class C IP)

SID = 5 bits

Subnet 1D = 200.196.78.<u>01001</u>000

Subnet number = 01001

= 8 + 1 + 1

= 10

3. (d)

Number of IP addresses = 512

Number of bits = 9 bits

HID bits = 9 bits

Last 9 bits of the network must be 0.00000001 to assign first host

(a) 118.17.00001111.00000000 **Invalid**

(b) 118.17.00001110.00000000 **Invalid**

(c) 118.17.00001110.00001111 **Invalid**

(d) 118.17.00001110.00000001 **Valid**

Hence, option (d) is correct.

4. (c)

Supernet mask = 255.252.0.0

- It can be supernet mask either for class B or Class C
- For class C number of networks can be combined $=2^{10} = 1024$
- For class B number of networks can be combined $= 2^2 = 4$

Maximum we can combine 1024 networks

5. (b)

Number of addresses = 720 (10 bits)

SM for class C = 255.255.255.0

NID = 24 bits

HID = 8 bits

- For 720 address 10 bit borrowed from NID

  Supernet mask

  = 11111111.11111100.00000000.00000000

  = 255.252.0.0

Hence option (b) is correct.

6. (1820)

- Class B
- By default SM for class B = 255.255.0.0
- To divide 4096 subnets, 12 bits needed
- First 16 bits are fix i.e 255.255
- Choose 12 bits out of 16

Total SM = ${}^{16}C_{12}$

$$= \frac{16*15*14*13}{4*3*2}$$

= 1820

7. (c)

IP address = 69.169.96.74

Subnet mask = 255.252.0.0

$$= \underbrace{11111111}_{\text{NID}}.\underbrace{111111}_{\text{SID}}\underbrace{00.00000000.00000000}_{\text{HID}}$$

<u>**Ankit Doyla Rule**</u>

128 64 32 16 8 4	Subnet number
0 0 0 0 0 0	1
0 0 1 0 1 0	11^{th} subnet

SID of 11^{th} subnet

= 69.00101000.00000000.00000000

= 69.40.0.0

186^{th} host of 11^{th} subnet = 69.40.0.186

= 69.40.0.10111010

= 01000101.00101000.00000000.10111010

Hence, option (c) is correct.

8. (a)

Source S SID = 200.16.85.79

255.255.245.224

200.16.85.64

Subnet ID = 200.16.85.01000000

Subnet number = 010

= 2 + 1

= 3

R_1 SID with IP address 200.16.85.98

SID = 200.16.85.96

= 200.16.85.01100000

Subnet number = 4

R_1 SID with IP address 200.16.85.77

SID = 200.16.85.64

Subnet number = 3

R_2 SID with IP address 200.16.85.119

SID = 200.16.85.96

Subnet number = 4

R_2 SID with IP address 200.16.85.79

SID = 200.16.85.64

Subnet number = 3

Destination 'D' SID

SID = 200.16.85.128

Subnet number = 5

- Subnet number 3 is same subnet with respect to sources i.e already exist in the network.

Hence, option (a) is correct.

9. (c)

S_1 IP = 212.128.17.58

S_2 IP = 212.128.17.33

S_2 SM = 11111111.11111111.11111111.11110000

= 255.255.255.240

S_2 SM = 11111111.11111111.11111111.11000000

= 255.255.255.192

For SM S_1:

$NID_{S_1S_1}$ = 255.255.255.240

212.128.17.58

212.128.17.48

$NID_{S_2P_1}$ = 255.255.255.240

212.128.17.33

212.128.17.32

Both NID are different with SM S_1. So, S_1 assume S_2 is on different network.

For SM S_2:

$NIDs_1s_2$ = 255.255.255.192

212.128.17.58

212.128.17.0

$NIDs_1s_2$ = 255.255.255.192

212.128.17.33

212.128.17.0

Both NID are same with SM S_2. So, S_2 assume S_1 is same Network.

Hence option (c) is correct.

10. (b, c, d)

Subnet mask

= 11111111.11111111.11110000.00000000

HID bits = 12 bits

In the network last 12 bits must be 1111.11111111

(a) 180.64.11111000.11111111 invalid

(b) 180.64.00111111.11111111 Valid

(c) 180.64.01111111.11111111 Valid

(d) 180.64.11111111.11111111 valid.

Hence, option (b, c, d) are correct.

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 04
Subject : Computer Networks

Maximum Marks 12

Q.1 to 4 Carry ONE Mark Each

[MCQ]

1. Consider generator polynomial function G(x) is $X^3 + 1$, the data stream at sender end is **10110101110101**, then calculate CRC?

(a) 100 (b) 110
(c) 101 (d) 010

[MSQ]

2. Which of the following is/are true property of the CRC generator?

(a) CRC generator should have at least two terms.
(b) The coefficient of the term x^0 should be 1.
(c) CRC generator should not divide $x^t + 1$, for t between 2 and n–1.
(d) CRC generator should have the factor $x + 1$

[NAT]

3. Consider hamming code (Single bit error detection and correction technique), the minimum parity bits needed for 90 data bits is ______.

[NAT]

4. A bit stream 1101100010100 is transmitted from the sender side and the transmission uses CRC method for error control in data link layer. If the generator polynomial is $x^3 + x^2 + 1$. What will be the actual bit string transmitted [in decimal]?

Q.5 to 8 Carry TWO Mark Each

[MSQ]

5. Dataword = d(x)
Codeword = c(x)
Generator = g(x)
Syndrome = s(x)
Error = e(x)
Which of the following statement is/are true

(a) if (x) ≠ 0 then code word is rejected and CRC scheme is working find
(b) CRC is Not perfect scheme if e(x) is divisible by g(x) then that error can't be detected.
(c) if S(x) =0 and e(x) ≠ 0 [e(x) is divisible by g(x)] then code wore accepted and CRC scheme failed to detect error.
(d) If s(x) = 0 and e(x) =0 then code word is accepted & CRC scheme is working find

[NAT]

6. Consider a hamming codeword consisting of 12 bits . In which 8 are data bits and 4 are parity check bits. If receiver receives the 12 bits hamming codeword as 011100101110 then calculate the bit number which got corrupted to noise [Note: start counting the bit stream MSB to LSB as 1–12]

[MCQ]

7. Given are
$d(x) = x^9 + x^7 + x^3 + x^2 + 1$
$g(x) = x^5 + x^4 + x^2 + 1$
Determine message to send c(x) = ?

(a) 101000110101110
(b) 101000110101101
(c) 101000110100111
(d) 101000110111100

[NAT]

8. Consider a code with only four valid code works 0000 000000,0000011111, 1111100000, 1111111111 assume minimum hamming distance of a code is ‘x’ and maximum hamming distance of a code is ‘y’ and maximum No. of erroneous bits that can be detected by code is z and maximum No of erroneous bit that can be corrected by the code is w, then value of x +z+w –y___.

Answer Key

1. **(d)**
2. **(a,b,c,d)**
3. **(7)**
4. **(55461)**
5. **(a,b,c,d)**
6. **(5)**
7. **(a)**
8. **(1)**

Hints and Solutions

1. (d)

$G(x) = x^3 + 1$

$1.x^3 + 0.x^2 + 0.x^1 + 1x^0$

1001

Sender

```
1001)10110101110101000
      1001
      00100101110101000
        1001
        000001110101000
             1001
             0111101000
              1001
              011001000
               1001
               01011000
                1001
                0010000
                  1001
                  00010
```

2. (a,b,c,d)

3. (7)

$\boxed{m + r + 1 \le 2^r}$ m = 90

$r = 6 \Rightarrow 90 + 6 + 1 \le 2^6$, $97 \le 64$ (no)

$r = 7 \Rightarrow 90 + 7 + 1 \le 2^7$ $98 \le 128$ (yes)

4. $(55461)_{10}$

Generator $= x^3 + x^2 + 1$

$= 1.x^3 + 1.x^2 + 0.x^1 + 1.x^0$

$= 1101$

```
1101 ) 1 1 0 1 1 0 0 0 1 0 1 0 0 0 0 0
       1 1 0 1
       0 0 0 0 1 0 0 0 1 0 1 0 0 0 0 0
               1 1 0 1
         0 1 0 1 1 0 1 0 0 0 0 0
           1 1 0 1
         0 1 1 0 0 1 0 0 0 0 0
           1 1 0 1
             0 0 0 1 1 0 0 0 0 0
                   1 1 0 1
               0 0 0 1 0 0 0
                     1 1 0 1
                     0[1 0 1]
```

CRC Remainder

Transmitted data $= (1101100010100101)_2$

$= (55461)_{10}$

5. (a,b,c,d)

Recived code word = c(x) +e(x)

$$\frac{\text{Received codeword}}{g(x)} = \frac{c(x)}{g(x)} + \frac{e(x)}{g(x)} = 0$$

$$\frac{c(x)}{g(x)} = 0 \ \boxed{\text{According to CRC defination}}$$

6. (7)

Odd Parity is preferable over even parity

P_1	P_2	3	P_4	5	6	7	P_8	9	10	11	12
0	1	1	1	0	0	1	0	1	1	1	0

P_1

1, 3, 5, 7, 9, 11

0, 1, 0, 1, 1, 1 $\rightarrow$ (even) (False) (P_1 =1)

P_2

2, 3, 6, 7, 10, 11

1, 1, 0, 1, 1, 1 $\rightarrow$ (Odd) (True) (P_2 =1)

P_4

4, 5, 6, 7, 12

1, 0, 0, 1, 0 $\rightarrow$ (even) (False) (P_4 =1)

P_8

8, 9, 10, 11, 12

0, 1, 1, 1, 0 $\rightarrow$ (Odd) (True) (P_8 =1)

P_8 P_4 P_2 P_8

0 1 0 1

$\Downarrow$

d.value = 5th bit gor corrupted

7. (a)

$d(x) = x^9 + x^7 + x^3 + x^2 + 1 = 1\cdot x^9 + 0\cdot x^8 + 1\cdot x^7 + 0\cdot x^6 + 0\cdot x^5 + 0\cdot x^4 + 1\cdot x^3 + 1\cdot x^2 + 0\cdot x^1 + 1\cdot x^0$

$g(x) = x^5 + x^4 + x^2 + 1 \Rightarrow 1\cdot x^5 + 1\cdot x^4 + 0\cdot x^3 + 1\cdot x^2 + 0\cdot x^1 + 1\cdot x^0 = 11010$

```
110101 ) 101000110100000
         110101
         ---------------
         011101110100000
          110101
          --------------
          00111010100000
            110101
          --------------
          001111100000
            110101
          ------------
            0010110000
              110101
            ----------
             01100100
              110101
             --------
              00[01110]
```

Remainder CRC

Code word = 101000110101110

Code word = 101000110100000

+ 01110

101000110101110

8. (a)

d (a, b) = 5

d (a, c) = 5

d (a, d) = 10

d (b, c) = 10

d (b, d) = 5

d (c, d) = 5

Minimum hamming distance = 5 (x)

Maiximum hamming distance = 10(y)

d + 1 = 5

d = 4(z)

2d + 1 = 5

2d = 4

d = 2(w)

x + z + w – y = 5 + 4 + 2 – 10 = 1

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 05

Subject : Computer Networks

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MSQ]

1. Which of the following statement(s) is/are true.

S_1: The maximum window size for data transmission using Go-Back-N-ARQ protocol with n bit frame sequence number is $2^n–1$.

S_2: The maximum window size for data transmission using selective repeat protocol with n bit frame sequence number is $2^n–1$.

S_3: The maximum window size for data transmission using selective repeat protocol with n bit frame sequence is $2^{n–1}$.

(a) S_1 (b) S_2
(c) S_3 (d) None of these

[MCQ]

2. A transmission channel has a bit rate of 8kbps and round trip time 40 msec is given. The cannel uses stop & wait protocol. Consider the transmission time of acknowledgement frame as negligible. What will be the frame size if channel efficiency is 75% (in bytes)?

(a) 240 (b) 30
(c) 120 (d) 160

[NAT]

3. Stop and wait protocol is used to transfer data across the link. On this wireless link the probability of a packet being corrupted is 0.1. What will be the average number of transmission attempts required to transfer 1800 packets.

[MCQ]

4. A host X uses 64 bytes packets to transmit message to host B using sliding window protocol. The one-way propagation delay is 40 msec. and the bottleneck bandwidth on the path between X and Y is 512 kbps. Calculate the optional window size that should be used by host X.

(a) 51 (b) 41
(c) 81 (d) 80

[NAT]

5. In selective repeat protocol if 6 bit sequence number is used then consider the following two statements.

S_1: The maximum sender window size will be 63.
S_2: The maximum sender window size will be 32.
S_3: The maximum window size will be 1.
S_4: The maximum receiver window size will be 32.

The number of true statements are ____.

Q.5 to 10 Carry TWO Mark Each

[NAT]

6. From an earth station a 1000 bytes packet is being transmitted to satellite. The distance between satellite and earth station is 2400 km. and the link has a bandwidth of 100 Mbps. The signal propagates at a speed of $3×10^8$ m/sec. Then calculate the link utilization by using stop and wait protocol (in percentage up to two decimal places).

[MCQ]

7. Consider two system wants to establish connection between themselves. The distance between these two stations is 900 km. The bandwidth of the network is 400 Mbps and the signal is propagating at a speed of $3×10^8$ m/sec. Suppose host X wants to send a 10^5 bits packet to another host Y. If network is using its full capacity, then calculate the minimum size of the sequence number in bits if selective repeat protocol is used.

(a) 5 (b) 6
(c) 4 (d) None of the above

[MSQ]

8. Which of the following statement(s) is/are true regarding stop and wait and sliding window protocols in terms of the buffer size?

(a) The buffer size in stop wait protocol is N+1.
(b) The buffer size Go-Back-N-ARQ protocol is N+1.
(c) The buffer size in selective repeat protocol is N+N.
(d) The buffer size in stop and wait protocol is 1+1.

[MSQ]

9. Select the true statements that apply to the continuous ARQ method's use of error retransmission.

(a) Go-Back-N-ARQ has better line utilization.
(b) Selective repeat has better line utilization.
(c) Selective repeat involves complex login than Go-Bank-N-ARQ
(d) Go-Back-N method required more storage at receiving site.

[MCQ]

10. In selective repeat ARQ protocol if the maximum sender window size is w, then what will be the number of sequence bit?

(a) $\log_2 (w + 1)$ (b) $\log_2 (w)$
(c) $\log_2 (2w)$ (d) $\log_2\left(\frac{w+1}{2}\right)$

Answer Key

1. (a,c)
2. (b)
3. (Range 2000 to 2000)
4. (c)
5. (2)
6. (Range 0.48 to 0.50)
7. (b)
8. (b,c,d)
9. (b,c)
10. (c)

Hints and Solutions

1. (a,c)

The maximum window size for data transmission using Go-Back-N-ARQ and selective repeat protocol with n bit frame sequence number are 2^n-1 and 2^{n-1} respectively.

2. (b)

$$\eta = \frac{\text{useful time}}{\text{total time}}$$

$$\frac{3}{4} = \frac{t_d}{RTT}$$

$$4 \times t_d = 3 \times RTT$$

$$t_d = \frac{3 \times RTT}{4}$$

$$\frac{l}{B} = \frac{3 \times RTT}{4}$$

$$l = \frac{3 \times RTT \times B}{4}$$

$$l = \frac{3 \times 40 \times 10^{-3}\,\text{sec} \;\times 8 \times 10^3\,\text{bits/sec.}}{4}$$

$$l = \frac{3 \times 40 \times 8}{4}$$

$$l = 240 \text{ bits}$$

$$l = \frac{240}{8} = 30 \text{ Bytes}$$

3. (Range 2000 to 2000)

If probability of a packet being lost = 0.1

Then expectation number to transmits one packet = $\frac{1}{1-0.1} = \frac{1}{0.9}$

To transmits 1800 packets = $1800 \times \frac{10}{0.9}$

= 2000 attempts are needed.

4. (c)

$$t_t\,(\text{packet}) = \frac{64 \text{ bytes}}{512 \text{ kbps}} = \frac{64 \times 8 \text{ bits}}{512 \text{ kbps}}$$

$$= \frac{512}{512} \times 10^{-3} = 1\text{msec.}$$

Bottleneck bandwidth ⇒ 100% utilization

$t_p = 40$ msec.

$$\eta = \frac{w \times t_t}{t_t + 2 \times t_p}$$

$$1 = \frac{w \times 1}{1 + 2 \times 40}$$

$$\boxed{w = 81}$$

5. (2)

In selective repeat is sequence number is N then

S.W.S. $= 2^{n-1}$
$= 2^{6-1}$
$= 2^5$
$= 32$

R.W.S. $= 2^{n-1}$
$= 2^{6-1}$
$= 2^5$
$= 32$

Hence, Statement S2 & S4 are true.

6. (Range 0.48 to 0.50)

Given

Packet size = 1000 byte
l = 2400 km
Bandwidth = 1000 Mbps
v = 3×100 m/sec.

Propagation delay (t_p) $= \frac{l}{v}$

$$= \frac{2400 \times 10^3 \text{ m}}{3 \times 10^8 \text{ m/sec}}$$

$= 8 \times 10^{-3}$ sec.

= 8 msec.

Transmission time $(t_t) = \dfrac{\text{Packet size}}{\text{Bandwidth}}$

$= \dfrac{1000 \text{ bytes}}{100\times10^6 \text{ bits/sec.}}$

$= \dfrac{1000 \times 8 \text{ bits}}{100\times10^6 \text{ bits/sec.}}$

$= 80\times10^{-6}$ sec.

$= 0.08$ msec.

Efficiency (link utilization) $= \dfrac{t_t}{t_t + 2tp}$

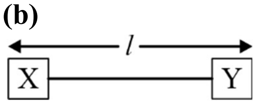
$= \dfrac{0.08}{0.08 + 2 \times 8}$

$= \dfrac{1}{1 + 2\times\dfrac{800}{0.08}}$

$= \dfrac{1}{1+200} = \dfrac{1}{201}$

$= 0.00497 = 0.49\%$

7. (b)



l = 900 km
Bandiwdth = 400 mbps
Packets size = 10^5 bits
Full capacity $\Rightarrow$ 100% link utilization
$v = 3\times10^8$ m/sec.

Transmission time $(t_t) = \dfrac{\text{Packet size}}{\text{Bandwidth}}$

$= \dfrac{10^5 \text{bits}}{400\times10^6 \text{bits/sec.}}$

$= 0.25$ m/sec.

Propagation time $(t_p) = \dfrac{l}{v}$

$= \dfrac{900\times10^3 \text{ m}}{3\times10^8 \text{ m/sec.}}$

$= 3\times10^{-3}$ sec. = 3msec.

$\eta = \dfrac{w \times t_t}{t_t + 2\times t_p}$

$100\% = \dfrac{w \times 0.25}{0.25 + 2\times 3}$

$0.25 + 6 = w\times 0.25$

$w = \dfrac{6.25}{0.25} = 25$

We know that window size in selective repeat is
$w = 2^{n-1}$
$2^{n-1} = 25$
$2^n = 50$
$2^n \approx 2^6$
$\boxed{n \simeq 6}$ bits

8. (b.c,d)

	Stop and wait	GBN	SR
Buffer	1+1	N+1	N+N

9. (b, c)

Selective repeat has better line utilization as compare to Go-Back-N-ARQ and selective repeat involves complex login than Go-Back-N-ARQ.

10. (c)

In selective repeat protocol:
Sender window size = w
$2^{n-1} = w$
$2^n = 2w$
$\boxed{n = \log_2(2w)}$

Branch : CSE & IT Batch : Hinglish

WEEKLY TEST – 06

Subject : Computer Networks

Topic : IPv4 and Fragmentation

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. A datagram of 7000 byte (20 bytes IP header) + (6980 bytes IP payload) reach at a router and must be formed to a link with MTU of 1200 bytes what is the offset value, MF value, total length of the last fragment.
(a) MF = 1, Total length = 1200, offset = 735
(b) MF = 0, Total length = 1196, offset = 735
(c) MF = 0, Total length = 1120, offset = 735
(d) MF = 0, Total length = 1120, offset = 5880

[MCQ]

2. Host a send a TCP packet containing 8880 byteS of user data to Host – B over an ethernet LAN. Ethernet LAN frames may carry data upto 1500 byteS (i.e. MTU = 1500 ByteS) size of TCP Header is 40 byte and size of IP Header is 20 bytes. How many total numbers of Fragment will be transmitted, what is offset value of last fragment and what is the total length of last fragment.
(a) 6, 925, 40
(b) 7, 1110, 60
(c) 7, 1110, 40
(d) 6, 1110, 1480

[NAT]

3. An IPV4 datagram, the M bit is O, the value of HLEN is 15, the value of total length is 600 and fragment offset value is 400.
If the sequence number of first byte of this datagram is 'a' and last byte is 'b' then what will be the value of 'a + b' ?

[NAT]

4. Suppose a TCP massage that contains 2048 bytes of user data and 20 byte of TCP header is passed to IP for delivery across two networks of the internet. The first network user MTU 1024 bytes and second network uses MTU 512 bytes. Each network MTU gives the size of largest IP datagram that can be carried in a link larger frame. Assume all IP headers are 20 bytes. Calculate total number of fragments that are received by destination.

[NAT]

5. An IP datagram of size 2000 bytes arrives at a router, the router has forwarded this packet on a link with MTU size 512 bytes The IP header is of 20 bytes. What will be the fragment offset value of the fourth fragment.

Q.5 to 10 Carry TWO Mark Each

[MSQ]

6. Which of the following option is true regarding option field in IPv4?
(a) If the header length is greater than 5 (HLEN $\geq$ 5) it means that the options field is present and must be considered.
(b) Copied, option class, and option number are sometimes referred to as single eight bit field, the option field.
(c) The value of "Type" in the security option field of an IPv4 header is 131.
(d) None of the above.

[NAT]

7. In an IP packet, the IP header has value of TTL field as 10110101 in binary than calculate the number of hops this packet can travel.

[MSQ]

8. An IP packet has arrived with first 8 bits as 01000011 which of the following options are false?
(a) The total number of bytes in header is 20 bytes.
(b) The number of hops this packet will travel is 2.
(c) The receiver will reject the packet.

(d) The total number of bytes in header is 8 bytes

[MSQ]

9. Which of the following fields in IPv4 datagram is/are related to fragmentation?

(a) Identification
(b) flag
(c) Type of services
(d) Fragment offset.

[MCQ]

10. Which of the following is correct option about the IPv4 fields?

(a) In IPv4 header the fragment offset field is of 16 bits.
(b) In IPv4 header the fragment offset field is of 13 bits.
(c) In IPv4 the protocol field is of 16 bits.
(d) None of the above.

Answer Key

1. (c)
2. (b)
3. (6939)
4. (7 to 7)
5. (183 to 183)
6. (c)
7. (181 to 181)
8. (a, b, d)
9. (a, b, d)
10. (b)

Hints and Solutions

1. **(c)**

MTU

20	1180

20	6980

datagram

Number of fragment $= \left\lceil \frac{6980}{1180} \right\rceil$

$= \lceil 5.91 \rceil$

$= 6$

	1	2	3	4	5	6
	20 | 1176	20 | 1176	20 | 1176	20 | 1176	20 | 1176	20 | 1100
MF	1	1	1	1	1	0
Offset	0 – 146	147 – 293	294 – 440	441 – 587	588 – 734	735 – 872

$\boxed{\frac{1176}{8} = 147}$

Last fragment $\boxed{20 \mid 1100}$

MF = 0

Off Set = 735

Total length = 20 + 1100

Total length = 1120

2. **(b)**

TCP packet user data = 8880 bytes

TCP header = 40 bytes

IP header = 20 bytes

NH	TH	Data

20	40	8880

↓

IP packet payload

MTU = 1500 byte

——————⊗——————

20	1480

Number of fragments $= \left\lceil \frac{40 + 8880}{1480} \right\rceil$

$= \left\lceil \frac{8920}{1480} \right\rceil$

$= \lceil 6.02 \rceil = 7$

20 | 1480	20 | 1480	20 | 1480	20 | 1480	20 | 1480	20 | 1480	20 | 40

Last fragment → $\boxed{20 \mid 40}$

Total length = 20 + 40 = 60

Offset $= \frac{6 \times 1480}{8}$

$= \frac{8880}{8}$

$= 1110$

3. **(6939)**

Range 6938 – 6940

M = 0 means it is the last fragment

HLEN = 15

Header size = 15 × 4

= 60 bytes

60	540

Offset value = 400

Address of first byte = 400 × 8 = 3200

Address of last byte = 3200 + 539 = 3739

a + b = 3200 + 3739

= 6939

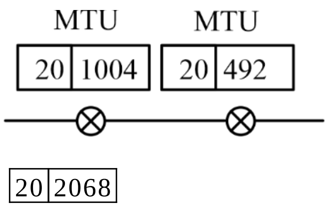
4. **(7 to 7)**

TCP massage user data = 2048

TCP header = 20 bytes

IP packet payload = 2048 + 20

= 2068 bytes



IP datagram

Number of fragments in first network $= \left\lceil \dfrac{2068}{1004} \right\rceil$

$= \lceil 2.05 \rceil = 3$

After first network:

20 | 1000	20 | 1000	20 | 68
I^{st}	II^{nd}	III^{rd}

In second Network:

Number of fragment of I^{st} fragment $= \left\lceil \dfrac{1000}{492} \right\rceil$

$= \lceil 2.03 \rceil$

$= 3$

Number of fragment of II^{nd} fragment $= \left\lceil \dfrac{1000}{492} \right\rceil$

$= \lceil 2.03 \rceil$

$= 3$

Number of fragment of III^{rd} fragment = 1

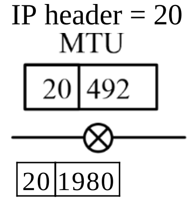
Total number of fragment $= 3 + 3 + 1$

$= 7$

5. (183 to 183)

IP datagram = 2000 bytes

IP header = 20 bytes



Number of fragment $= \left\lceil \dfrac{1480}{492} \right\rceil = \lceil 4.02 \rceil = 5$

I^{st}	II^{nd}	III^{rd}	Iv^{th}	V^{th}
20 | 488	20 | 488	20 | 488	20 | 488	20 | 28

Fragment offset value of fourth fragment $= \dfrac{3 \times 488}{8}$

$= 183$

6. (c)

Option C is false, since the value of 'Type' in the security option field of an IP header is 130.

7. (181 to 181)

$(10110101)_2 = (181)_{10}$

Total number of hops = 181

8. (a, b, d)

0100 $\downarrow$ IP version

0011 $\downarrow$ HLEN

$(0100)_2 = 4$ (IPv4)

$(0011)_2 = 3 \times 4 = 12$ bytes

Header should be between 20 – 60 bytes. Hence, the receiver will reject the packet.

9. (a, b, d)

flag, identification, and fragment offset fields are related to fragmentation.

10. (b)

Fragment offset = 13 bits

Protocol field = 8 bits.

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 07

Subject : Computer Networks

Topic : TCP & UDP

Maximum Marks 12

Q.1 to 4 Carry ONE Mark Each

[MCQ]

1. Silly window syndrome is related to_________.
(a) Error during transmission
(b) File transfer protocol
(c) Degrade in TCP performance
(d) Interface problem

[MCQ]

2. Which of the following is a transport layer protocol?
(a) Stream control transmission protocol
(b) Internet control message protocol
(c) Neighbor discovery protocol
(d) Dynamic host configuration protocol

[MCQ]

3. Nagle's algorithm can solve the silly window syndrome created by the__________.
(a) Sender
(b) Receiver
(c) Sender and Receiver
(d) None of the above

[MCQ]

4. Clark's solution can solve the silly window syndrome created by the_________.
(a) Sender
(b) Receiver
(c) Sender and Receiver
(d) None of the above.

Q.5 to 10 Carry TWO Mark Each

[NAT]

5. Suppose that the TCP congestion window is set to 18KB and a time out occurs. How big will the window (in MSS) be if the next four transmission burst are all successful? (Assume that MSS is 1KB).

[NAT]

6. Let the size of congestion window of a TCP connection be 16KB when a time out occurs. The round trip time of the connection is 200 msec. and the maximum segment size used is 2 KB. The time taken by the TCP connection (in msec.) to get back to 16 KB congestion window is________.

[MSQ]

7. A UDP header is given as:
$(\text{FFF0 0050 FFFE FFFF})_{16}$
Consider the following option.
(a) The destination port value is 80.
(b) The source port value is 80.
(c) The source port value is 65520.
(d) The size of play load is 65528.

[MCQ]

8. Consider the slow start phase for a congestion control in a TCP connection initially, the window size is 4 MSS and the threshold is 36 MSS. After which transmission window size reached the threshold limit?
(a) 3 (b) 4
(c) 5 (d) 7

Answer Key

1. (c)
2. (a)
3. (a)
4. (b)
5. (9 to 9)
6. (1200 to 1200)
7. (a,c,d)
8. (b)

Hints and Solutions

1. (c)
Whenever the application is generating the data slowly and still uses TCP protocol than window size will be small and utilization will be less this problem is know as "Silly Window Syndrome".

2. (a)
Stream control transmission protocol (SCTP) in a transport layer protocol used in networking system where streams of data are to be continuously transmitted between to connected network nodes.

3. (a)
Nagle's algorithm suggested that send that first byte as it is and start buffering the remaining data.
Once the ACK segment reaches to the client compare the buffer size with the window size.
When the buffer size > window size.
Sender has to wait until buffer size = window size and start trammitting the data.

4. (b)
Clark's solution suggest that delay in ACK so that the next time window size will increase along will buffer size. Clark's solution can solve window syndrome created by receivers.

5. (9 to 9)
Time out occur when window size = 18KB

Threshold = $\dfrac{18\text{KB}}{2} = 9\text{KB}$

Slow start phare
1 MSS – 1st transmission
2 MSS – IInd transmission
4 MSS – IIrd transmission
8 MSS – IVth transmission
9 MSS – Vth transmission
After four successful transmission the window size will be = $\boxed{9\text{ MSS}}$ **or** $\boxed{9\text{ KB}}$

6. (1200 to 1200)
Congestion window = 16 KB

Threshold = $\dfrac{16\text{KB}}{2} = 8\text{KB}$

$$\left.\begin{array}{l}2\text{KB}\\4\text{KB}\\8\text{KB}\end{array}\right\}\text{Slow start phase}$$

$$\left.\begin{array}{l}8\text{KB}\\12\text{KB}\\14\text{KB}\\16\text{KB}\end{array}\right\}\text{congestion avoidence}$$

Time taken to reach 16KB = 6×200 = 1200 msec.

7. (a,c,d)
UDP header = 8 bytes
= 64 bits

Source port 16 bits	Destination port 16 bits
Total length 16 bits	Checksum 16 bits

Source port = $(\text{FFF0})_{16}$
= $(1111\ 1111\ 1111\ 0000)_2$
= 65520

Destination port = $(0050)_{16}$
= $(0000\ 0000\ 0101\ 0000)_2$
= 80

Size of datagram = $(\text{FFFE})_{16}$
= $(1111\ 1111\ 1111\ 1110)_2$
= 65534

Payload = Total length of datagram– UDP header
= 65534 – 8
$\boxed{\text{Payload} = 65528}$

8. (b)

$$\underset{}{4\text{ MSS}} \;|\; \underset{\text{I}^{\text{st}}\text{ transmission}}{8\text{ MSS}} \;|\; \underset{\text{II}^{\text{nd}}\text{ transmission}}{16\text{ MSS}} \;|\; \underset{\text{III}^{\text{rd}}\text{ transmission}}{32\text{ MSS}} \;|\; \underset{\text{IV}^{\text{th}}\text{ transmission}}{36\text{ MSS}}$$

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 08

Subject : Computer Networks

Topic : TCP & UDP

Maximum Marks 19

Q.1 to 7 Carry ONE Mark Each

[MSQ]

1. Which of the following are the services provided by the transport layer?
(a) Reliable delivery
(b) Multiplexing
(c) End – to – End delivery
(d) Flow control

[MCQ]

2. Match List-I with the List-II:

List-I		List-II	
(A)	CLOSED	(I)	The application has said it is finished
(B)	LISTEN	(II)	The other side has agreed to release
(C)	FIN WAIT 1	(III)	The server is waiting for an incoming call.
(D)	FIN WAIT 2	(IV)	No connection is active or pending

Choose the correct answer from the options given below:
(a) A – I, B-II, C-III, D-IV
(b) A –IV, B-III, C-II, D-I
(c) A – IV, B-III, C-I, D-II
(d) A – IV, B-II, C-I, D-III

[MSQ]

3. If a WAN Link is 2 Mbps and RTT between source and destination is 200 msec. then what will be the optimal TCP window size needed to fully utilize the line?
(a) 200000 bits (b) 25000 bits
(c) 20000 bytes (d) 25000 bytes

[MSQ]

4. Silly window syndrome is a problem that arises due to the poor implementation of TCP. Which of the following are the cause of silly window syndrome?
(a) Receiver transmitting data in small segments repeatedly.
(b) Sender transmitting data in small segment repeatedly.
(c) Receiver accepting only few bytes at a time repeatedly.
(d) Sender accepting only few bytes at a time repeatedly.

[MCQ]

5. Among the following TCP timer which of the following timer deal with a zero-window-size deadlock situation?
(a) Keep Alive Timer
(b) Time Wait Timer
(c) Time Out Timer
(d) Persistent Timer

[NAT]

6. Consider a network, in which the data transmission rate is 10 Mbps. It uses CSMA/CD in the MAC layer. The maximum signal propagation time from one node to another node is 50 microseconds. What is the minimum size of a frame in the network in bits?

[MCQ]

7. Which of the following option(s) is/are true?
(a) Pure aloha has maximum throughput 18.4%
(b) Slotted aloha has maximum throughput 36.8%
(c) In pure aloha, the probability of successful transmission of the data packet is $G \times e^{-2G}$.
(d) In slotted aloha the probability of successful transmission of the data packet is $G \times e^{-G}$.

Q.8 to 13 Carry TWO Mark Each

[NAT]

8. Consider the following statements:

S_1: When ACK field is set, then it validates the acknowledgement number.

S_2: The PSH field is used to inform the sender that higher throughout is needed so if possible, data must be pushed with higher throughput.

S_3. The reset bit is used to reset the TCP connection when there is any confusion occurs in the sequence number.

How many statements is/are true with respect to the flags in in TCP header?

[MSQ]

9. TCP uses several timers to ensure that excessive delays are not encountered during communication. Consider the following option and select the correct option among the following.

(a) TCP uses a time out timer for retransmission of lost segment

(b) TCP uses a time out timer during connection termination.

(c) TCP uses a time wait timer during connection termination.

(d) TCP user a time wait timer for retransmission of lost segment.

[NAT]

10. Suppose host A is sending a large file to host B over TCP connection. The round trip time (RTT) is 10 msec. The hosts are connected by 1 Gbps link.

Assuming that they are using the packet size 1000 bytes to transmit the file (ignore ACK packets). At least how big would the window size (in packets) have to be for the channel utilization to be greater than 80% ?

[NAT]

11. A TCP machine is sending windows of 65535B over 2 Gbps channel that has 40 msec. RTT. What is the maximum achievable throughput? (upto one decimal place Mbps.)

[MCQ]

12. The TCP sliding window

(a) Can be used to control the flow of information

(b) Always occurs when the field value is 0

(c) Always occurs when the field value is 1.

(d) Occurs horizontally.

[NAT]

13. Consider a LAN with five nodes. Time is divided into fixed-size slots. A node can begin its transmission only at the beginning of a slot. A collision occur if more than two nodes transmits in the same slot. The probabilities of generation of a frame in a time slot by these LAN are 0.2, 0.3, 0.25, 0.16 and 0.09 respectively. The probability of transmission in the first slot without any collision by any of these five station is_______.

Answer Key

1. (a,b,c,d)
2. (c)
3. (a, d)
4. (b, c)
5. (d)
6. (1000 to 1000)
7. (a,b,c,d)
8. (3 to 3)
9. (a,c)
10. (Range 1000 to 1000)
11. (Range 13.1 to 13.3)
12. (a)
13. (0.41 to 0.41)

Hints and Solutions

1. (a,b,c,d)

Transport larger services:

1. End - to - End delivery
2. Addressing
3. Reliable delivery
4. Flow control
5. Multiplexing

2. (c)

The correct matching is as following:

$A \rightarrow IV$

$B \rightarrow III$

$C \rightarrow I$

$D \rightarrow II$

3. (a, d)

Given,

Bandwidth = 2Mpbs

RTT = 200 msec.

Optional window size = max data which is sent in 1 RTT

= 1 Mbps × 200 msec.

= 1×10^6 bits/sec. × 200×10^{-3} sec.

= 200×10^3 bits

= 25000 bytes.

4. (b, c)

Causes of silly window syndrome.

(1) Sender transmitting data in small segment respectively.

(2) Receiver accepting only few bytes at a time repeatedly.

5. (d)

To deal with zero-window-size deadlock situation, TCP uses a persistent timer when the sending TCP receives an acknowledgement with a window size of zero, it starts a persistent timer.

6. (1000 to 1000)

For CSMA /CD

$T_t = \geq 2\, t_p$ ....(i)

T_t = transmission time

T_p = propagation time

T_p = 50 μsec. = 50×10^{-6} sec.

Bandwidth = 10 Mbps = 10×10^6 bits/sec.

$$t_t = \frac{L\left(\text{Size of frame}\right)}{\text{Bandwidth}}$$

From equation number (i)

$L \geq 2\times$ Bandwidth $\times\, t_p$

$\geq 2 \times 10 \times 10^6 \times 50 \times 10^{-6}$

$\boxed{L \geq 1000 \text{ bits}}$

7. (a,b,c,d)

All the given statements about pure and slotted are true.

8. (3 to 3)

All the given statements are true.

9. (a, c)

In TCP time out timer is used for retransmission of lost packet and time wait timer during connection termination.

10. (1000 to 1000)

Window size for 80% efficiency

Window size = 0.8× window size for 100% efficiency

= 0.8 × (max number of bits that can be transmitted in 1 RTT)

= 0.8 × 1 Gpbs × 10 msec.

= 0.8×10^9 bits /sec. × 10×10^{-3} msec.

= 8×10^6 bits

= 10^6 bytes

In terms of packets

$$\text{Window size} = \frac{10^6 \text{ bytes}}{\text{Packet size}} = \frac{10^6 \text{ bytes}}{10^3 \text{ bytes}} = 1000$$

11. (13.1 to 13.3)

Maximum achievable throughput

1 RTT – 65535 B

40 msec. – 65535 B

1 sec. – $\dfrac{65535 \text{ B}}{40\times10^{-3}}$

1 sec. – 1638.375×10^3 bytes

1 sec. – 13107×10^3 bits

$\boxed{\text{throughput} = 13.107 \text{ Mbps}}$

12. (a)

TCP uses the sliding window mechanism for the flow control of data in transit on a network.

13. (0.41 to 0.41)

Let

$P_1 = 0.2$

$P_2 = 0.3$

$P_3 = 0.25$

$P_4 = 0.16$

$P_5 = 0.09$

Probability $= P_1(1 - P_2)(1 - P_3)(1 - P_4)(1 - P_5)$
$+ (1 - P_1) P_2(1 - P_3)(1 - P_4)(1 - P_5)$
$+ (1 - P_1)(1 - P_2) P_3(1 - P_4)(1 - P_5)$
$+(1 - P_1)(1 - P_2)(1 - P_3) P_4(1 - P_5)$
$+ (1 - P_1)(1 - P_2)(1 - P_3)(1 - P_4) P_5$
$= 0.080262 + 0.137592 + 0.107016 + 0.061152 + 0.031752$
$= 0.4177$

Branch : CSE & IT   Batch : Hinglish

WEEKLY TEST – 09

Subject : Computer Networks

Topic : Routing Protocol and Switching

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

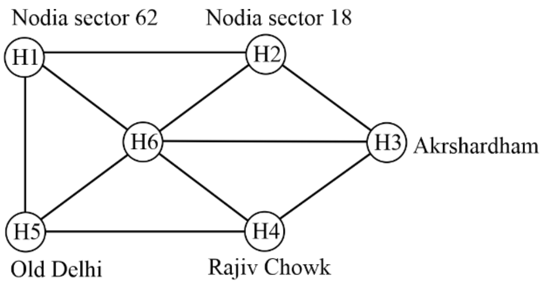
[MCQ]

1. Which of the following technique is used in traditional telephone system?
(a) Circuit switching
(b) Packet switching
(c) Datagram packet switching
(d) None of the above

[MCQ]

2. Consider the following network and its corresponding distance vector table mentioned in some units and unknown through which cities.

	H1	H2	H3	H4	H5	H6
H1	0	2	2	2	4	1
H2	2	0	2	3	6	3
H3	2	2	0	1	3	1
H4	2	3	1	0	2	1
H5	4	6	3	2	0	3
H6	1	3	1	1	3	0



Also (H1, H6) =1 (H2, H6) =3, (H3 , H6) =1, (H5, H6) =4, A new highway is built between Mandi house, Rajeev Chowk, making to distance two cities to 6 units i.e. (H4, H6) = 6, units. The new distance vector of Mandi house.

(a)

1	3	1	2	2	0

(b)

1	3	1	2	4	0

(c)

1	3	1	4	1	0

(d)

1	3	1	1	4	0

[MSQ]

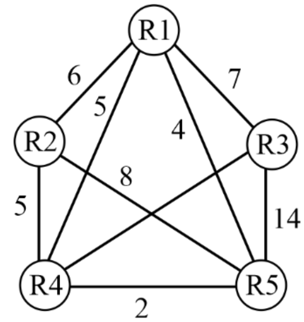
3. Dynamic routing protocol enables routers to-
(a) Dynamically discover and maintain routers.
(b) Dynamically routing updates to other routers.
(c) Reach agreement with other routers about the network topology.
(d) Not distribute routing updates to other routers.

[MCQ]

4. In a packet switching network, packet are routed from source to destination along a single path having two intermediate nodes. If the message size is 50 bytes and each packet contains a header of 4 bytes then the optimal packets size is-
(a) 12 bytes (b) 13 bytes
(c) 14 bytes (d) 15 bytes

[MCQ]

5. Consider a network with 5 routers R_1 to R_5 connected with links having weight shown in the following diagram:



All the routers use the distance vector-based routing algorithm to update their routing tables. Each router starts with its routing table initialized to contain an entry for each neighbor with the weight of the respective connecting link. After all the routing tables stabilize, then what will be the distance vector at router R5 ?

(a)

	R1	R2	R3	R4	R5
R5	4	8	14	2	0

(b)

	R1	R2	R3	R4	R5
R5	4	7	11	2	0

(c)

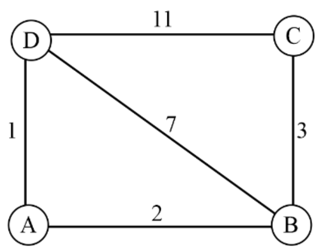
	R1	R2	R3	R4	R5
R5	4	7	14	5	0

(d) None of the above

Q.6 to 10 Carry TWO Mark Each

[MCQ]

6. Consider the following network 4 routers.



What will be the routing table at node C after finalizing of the network?

(a)

Destination	Distance	Next Hop
A	5	B
B	3	-
C	0	-
D	6	B

(b)

Destination	Distance	Next Hop
A	5	B
B	3	-
C	0	-
D	10	B

(c)

Destination	Distance	Next Hop
A	5	B
B	3	-
C	0	-
D	11	B

(d) None of these

[NAT]

7. Consider the following Statements:

S_1: Using Distance vector (DV) with split horizon there is no count to infinity problem.

S_2: Link state Routing (LSR) algorithm is fast convergence algorithm because whenever the link is broken it will be take 0(1) time to reach to all nodes in the network.

S_3: In circuit switching congestion can occur during connection establishment whereas in packet switching congestion can occur during data transfer.

S_4: Circuit switching is preferable for long message whereas packet switching is preferable for short message.

How many are the total number of correct statements?

[MCQ]

8. Consider a network Raving 6 nodes A,B,C,D,E,F and the measured delay between A to B, A to D and A to C are 4,5,6 respectively. Which of the following is routing table of a using distance vector routing? The vector table of B,C, D are given as follows:

		A	**B**	**C**	**D**	**E**	**F**
Vector table of 'B'	=	2	0	4	4	3	2
Vector table of 'C'	=	5	4	0	2	7	4
Vector table of 'D'	=	5	1	3	0	3	6

(a)

A	B	C	D	E	F
0	4	6	5	7	6
-	B	C	D	B	B

(b)

A	B	C	D	E	F
0	6	6	4	5	7
-	B	C	D	B	B

(c)

A	B	C	D	E	F
0	4	6	6	5	7
-	B	C	D	B	B

(d)

A	B	C	D	E	F
0	5	4	6	6	5
-	B	C	D	B	B

[MCQ]

9. Which of the following protocols is used to find the best path for data transmission in a network?

(a) BGP (b) EIGRP

(c) OSPF (d) RIP

[MCQ]

10. The RIP routing protocol is based on an algorithm that is_______.

(a) An OSPF algorithm

(b) A link state algorithm

(c) A centralized routing algorithm

(d) Based on information received only form link neighbors.

Answer Key

1. **(a)**
2. **(b)**
3. **(a,b,c)**
4. **(c)**
5. **(b)**
6. **(a)**
7. **(4 to 4)**
8. **(a)**
9. **(b)**
10. **(d)**

Hints and Solutions

1. (a)
Circuit switching is used long- distance communication link that must be constant for lengthy period of time.

2. (b)
a = min (1 + 0, 3 + 2, 1+ 2, 6 +2, 4 + 4) =1
b = min (1 + 2, 3 + 0, 1+ 2, 6+3, 4 + 6) =3
c = min (1 + 2, 3 + 2, 1+ 0, 6+1, 4 + 3) =1
d = min (1 + 2, 3 + 3, 1+ 1, 6+0, 4 + 2) =4
The distance vector of Rajiv Chowk is:

1	3	1	2	4	0

3. (a,b,c)
Dynamic routing protocol enables router to dynamically discover and maintain router, distribute routing updates to other router and reach agreement with other routers about the networking topology.

4. (c)
A —— X —— X —— B

Message size = 50 bytes (M)
Header size = 4 bytes (h)
Number of hops (X) = 3
From the formula of optimal payload

$$P = \sqrt{\frac{Mh}{X-1}}$$

$$P = \sqrt{\frac{50\times 4}{3-1}}$$

$$= \sqrt{\frac{50\times 4}{2}} = \sqrt{100} = 10$$

Optimal packet size = p + h
= 10+ 4
= 14 bytes

5. (b)
The distance vector of R5 is:

4	7	11	2	0

6. (a)
The final routing table for 'c'.

Destination	Distance	Next Hop
A	5	B
B	3	-
C	0	-
D	6	B

7. (4 to 4)
All the written statements are true.

8. (a)
Routing table at A.

A	B	C	D	E	F
0	4	6	5	7	6
-	B	C	D	B	B

9. (b)
EIGRP (Enhance interior gateway routing protocol) is a hybrid routing protocol that combines the features of distance vector routing protocols with those of link state protocols. However EIGRP is proprietary protocol developed by CISCO system and is not widely used outside the CISCO network.

10. (d)
The Routing Information Protocol (RIP) is a routing protocol that is based on the distance-vector algorithm. The distance-vector algorithm is a method used by routers to determine the best path to a destination network.
In the distance-vector algorithm, each router maintains a table of distances to all known networks. These distances, also known as "vectors", are used to determine the shortest path to a destination network. When a router receives a packet, it compares the distance to the destination network to the distances of other known networks. If it determines that the path through another network is shorter, it will forward the packet to that network.

Branch : CSE & IT　　Batch : Hinglish

WEEKLY TEST – 01

Subject : Computer Organization and Architecture

Topic : Introduction to COA

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. A microprocessor has a data bus with 64 lines and an address bus with 32 lines. The maximum number of bits that can be stored in memory is________.

(a) 32×2^{12}　(b) 32×2^{64}

(c) 64×2^{32}　(d) 64×2^{64}

[MCQ]

2. Various storage device used by an operating system can be arranged as follows in increasing order of accessing speed.

(a) Secondary memory → main memory → cache memory → Register

(b) Main memory →Secondary memory→cache memory→Register

(c) Secondary memory →cache memory → main memory →Register

(d) Main memory → secondary memory→ Register → cache memory

[MCQ]

3. In the Big-Endian system, the computer stores.

(a) MSB of data in the lowest memory address of data unit.

(b) LSB of data in the lowest memory address of data unit.

(c) MSB of data in highest memory address of data unit.

(d) LSB of data in the highest memory address of data unit.

[MCQ]

4. Consider 32 bits stack CPU supports 1W opcode and 4GB RAM.

Following statement is executed in the system:

X = (A*B) (C+D)

How many machine instructions required for the given statement.

(a) 6　(b) 7

(c) 8　(d) None

[NAT]

5. Consider 32 bits hypothetical CPU which supports 1-word long instruction with 7 bits opcode, register operand field value 5 bits and a memory operand field. Then calculate the total memory size in MB.

Q.6 to 10 Carry TWO Mark Each

[NAT]

6. Consider a hypothetical CPU which supports instruction with 2 register operands and 1 memory operands. CPU supports 120 instructions, 24 register and 512 KB memory space. How many bits are required to encode the instructions.

[NAT]

7. Consider 32 bits CPU which supports 1 words instruction with 3 Register operands and immediate operands fields. Processer supports 7 bits opcode and 24 Register with register size of 32 bits. Instruction is placed in a 256KW memory. What is the largest unsigned constant possible in the instruction?

[NAT]

8. Consider 20 bits hypothetical CPU which supports 1 word instruction placed in a 8KW memory space. If there exits 126 one address instruction and a^b zero address instruction then calculate the value of a + b.

[MCQ]

9. Consider a hypothetical CPU which supports 84 instructions. Instruction format contain two registers operand, one memory operand and 13 bits immediate constant field. CPU supports 34 registers 256KB memory space. A process contains 100 instructions. How much storage space is required in bytes to store the process.

(a) 625 bytes
(b) 700 bytes
(c) 600 bytes
(d) 725 bytes

[NAT]

10. Consider 64 bits hypothetical CPU which supports one word instruction program is stored in the memory with a starting address of 1000 in decimal. Consider a processes P and 4 instructions. What will be the program counter (PC) value of during the execution of 3rd instruction?

Answer Key

1. **(c)**
2. **(a)**
3. **(a,d)**
4. **(c)**
5. **(4 to 4)**
6. **(36 to 36)**
7. **(1023 to 1023)**
8. **(16 to 16)**
9. **(b)**
10. **(1024 to 1024)**

Hints and Solutions

1. **(c)**

Data lines = 64 bits

Address lines = 32 bits

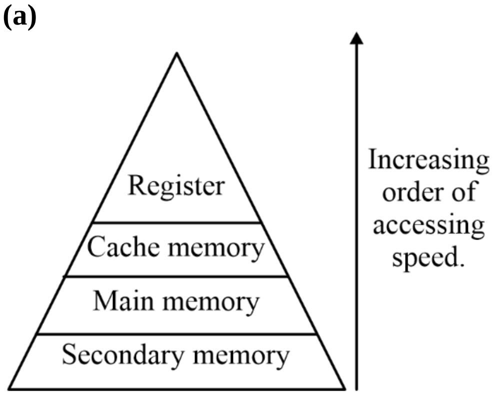
Number of memory location = 2^{32}

Block size = 64 bits.

Maximum number of bits stored in memory

$= 2^{32} \times 64$ bit

2. **(a)**



3. **(a,d)**

In Big Endian, lower address contains higher byte and higher address contain lower bytes.

4. **(c)**

X = (A*B) (C+D)

I_1: PUSH A

I_2: PUSH B

I_3: ADD

I_4: PUSH C

I_5: PUSH D

I_6: ADD

I_7: MUL

I_8: POP X

Total number of instructions required in stack CPU is 8.

5. **(Range 4 to 4)**

32 bits

Opcode	R	MR
7	5	

MR field = 32 – 12

= 20

Number of cells in memory = 2^{20}

Cell size = 7 + 5 + 20

= 4 bytes

Memory size = $2^{20} \times 4$ bytes

= 4 MB

6. **(Range 36 to 36)**

Instruction format:

Opcode	R_1	R_2	MR
7	5	5	19

Number of registers = 24

Number of bits required to locate register = $\lceil \log_2 24 \rceil$

= 5

Number of Instruction = 120

Opcode = $\lceil \log_2 120 \rceil = 7$

Memory space = 512 KB

Bits required to address memory cells = $\log_2 512$ K

$= \log_2 2^{19}$

= 19

Instruction size = 7 + 5 + 5 + 19

= 36

7. **(Rang 1023 to 1023)**

Instruction size = 32 bits

32 bits

Opcode	R_1	R_2	R_3	Immediate
7	5	5	5	x

Number of registers = 24

Bits required to represent a register = $\lceil \log_2 24 \rceil = 5$

Opcode = 7 bits

Immediate field value = 32 – (7 + 5 + 5 + 5)

x = 32 – 22

x = 10

The maximum unsigned constant value possible

$= 2^{10} - 1$

= 1023

8. (16)

← 20 bits →

Instruction	Opcode	Immediate
	←7→	← 13 →

Memory space = 8 KW

Memory address space $= \log_2 8K$

$= \log_2 2^{13}$

= 13

Total number of instructions $= 2^7$

= 128

Number of one address instruction = 126

Then number of zero address instruction

$= (128 - 126) \times 2^{13}$

$= 2 \times 2^{13}$

$= 2^{14}$

Answer = 2 + 14 = 16

9. (b)

Number of instructions = 84

Opcode $= \lceil \log_2 (84) \rceil = 7$ bits

Number of registers = 34

Number of bits required to locate a register $= \log_2 34$

= 6

Memory space = 256 KB

Address space $= \log_2 2^{18}$

= 18 bits

Opcode	R_1	R_2	MR	Immediate
←7→	←6→	←6→	←18→	←13→

One instruction size = 7 +6 + 6 + 18 + 13

= 50 bits

≅ 7 bytes

Note:- 50 bits ⇒ 6 bytes + 2 bits

By default, memory is byte addressable so 7 cell will be used for one instructions.

Process size =100 instruction

= 100× 7 cells

= 100 × 7 bytes

= 700 bytes

10. (Range 1024 to 1024)

Word size = 64 bits

= 8 bytes

Initial PC value = 1000

I_1 – 1000 – 1007

I_2 – 1008 – 1015

I_3 – 1016 – 1023

I_4 – 1024 – 1031

During the execution of I_3 instruction PC will store the address of next instruction.

$\boxed{PC \rightarrow 1024}$

Branch : CSE & IT Hinglish

WEEKLY TEST – 02

Computer Organization and Architecture

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. In which address mode, the effective address of the operand is generated by adding a constant value to the content of a register?
(a) Absolute mode
(b) Indirect mode
(c) Immediate mode
(d) Index mode

[MCQ]

2. Consider 4 byte long jump instruction stored in the memory with a starting address of $(200)_{10}$. Address filed of an instruction contain (–24), base register contain 400. Calculate the branch address when the instruction is designed using PC relative addressing mode?
(a) 180 (b) 80
(c) 204 (d) 24

[MSQ]

3. Which of the following address modes is/are the transfer of control addressing modes (AM^S).
(a) Indexed Address modes (AM^S)
(b) Relative /PC-relative AM^S
(c) Based/Based register AM^S
(d) Indirect Addressing modes (AM^S)

[MSQ]

4. Which of the following cannot be a valid instruction for an accumulator based computer system?
X, Y = Addresses, r_1, r_2 = Registers.
(a) Load X
(b) Push Y
(c) Add Y
(d) POP X

[NAT]

5. A 16 bit instruction is present in memory location starting at 250. The instruction is divided into two fields opcode and address of 8 bit each, where address field contains the value 232. What will be the effective address using direct addressing mode.
Consider the memory is byte addressable.

Q.6 to 10 Carry TWO Mark Each

[NAT]

6. Consider 500 MHZ clock frequency processor uses different operand accessing mode below.

Operand Accessing Modes	Frequencies %
Immediate	20
Register	20
Direct	20
Indirect	20
Register Indirect	10

Indexed	10

Also consider 4 cycles consumed for memory references 2 cycles consumed for ALU operation, 0 cycle consumed when the data is present in register and instruction itself. Calculate the average execution time up to one decimal place to fetch the operand?

[MCQ]

7. Which of the following statement(s) is true.

(a) Indexed addressing mode is used for branch instruction.

(b) If current running or branch instruction memory address is 456 and the PC-relative address field is 44.The current running instruction branch to 500 after its execution.

(c) Indirect addressing mode and base register addressing modes permits relocation without any change in code.

(d) For an indirect addressing mode, the address field in the instruction is the address of the effective address of the actual operand.

[NAT]

8. A CPU has 19 registers and uses 10 addressing modes. RAM is 8K × 32 and the instruction is of size 32 bits. What is the maximum size of the op-code field (in bits) if the instruction has a register operand and a memory address operand?

[MSQ]

9. In a computer, a memory unit is of size 256 KW, where W stands for word. Word size is 32 bits and instruction size is one word. Instruction sports 3 types of addressing modes (direct, indirect and registers AM^s)

The instruction has four parts:

Addressing mode, operation code, register code, and address part. An addressing mode part is used to specify one of the 64 registers.

Which of following given statements is/are true?

(a) Addressing mode part takes 2 bits.

(b) Register code takes 6 bits.

(c) Address part takes 18 bits.

(d) opcode part takes 6 bits.

[NAT]

10. Only instructions with zero, one and two addresses are supported by some CPUs, The size of an op-code field is of 8 bits, the instruction size is of 16 bits whereas the size of an address is 4 bits what is the maximum number of two address instructions?

Answer Key

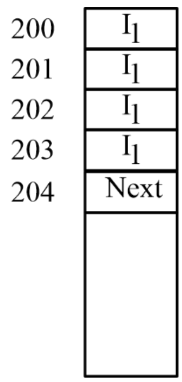
1. (d)
2. (a)
3. (b,c)
4. (b, d)
5. (232)
6. (6.8 to 6.8)
7. (d)
8. (10 to 10)
9. (a, b, c, d)
10. (256 to 256)

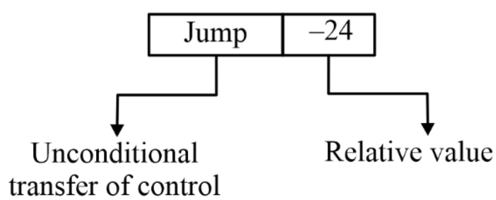
Hints and Solutions

1. (d)
In Index addressing mode, the content of a given Index register gets added to an instructions address part so as to obtain effective address.

2. (a)
By default memory is byte addressable.

Cell size = 8 bits
= 1 byte





PC- relative Addressing mode

Effective address = PC + relative value
= 204 – 24
= 180

PC : $\cancel{204}$ 180

3. (b,c)
Addressing modes

(i) Sequential control flow AM^S
(ii) Transfer of control flow AM^S

Sequential control flow AM^S

(i) Implied AM^S
(ii) Immediate AM^S
(iii) Direct AM^S
(iv) Indirect AM^S
(v) Indexed AM^S
(vi) Auto Indexed AM^S

Transfer of control flow AM^S

(i) Relative/PC-relative AM^S
(ii) Based /Based register AM^S

4. (b, d)
In single accumulator CPU organization, the first ALU operand is always stored into the accumulator and the second operand is present either in registers or in the memory.
Hence, Push B and POP are not a valid accumulator based instructions.

5. (232 to 232)
In direct addressing mode, the value at the address field is considered as the actual address of data.

250	opcode
251	232
252	

Effective address = 232

6. (Range 6.8 to 6.8)

$$\text{Cycle time} = \frac{1}{\text{Frequency}}$$

$$= \frac{1}{500\ \text{MHZ}} = .002\times 10^{-6}$$

= 2 nsec.

Immediate $\rightarrow$ 0 cycle

Register $\rightarrow$ 0 cycle

Direct $\rightarrow$ 1 memory Reference (MR) $\rightarrow$ 4 cycles

Indirect $\rightarrow$ 2 MR $\rightarrow$ 4 ×2 $\rightarrow$ 8 cycles

Register Indirect $\rightarrow$ 1MR$\rightarrow$ 4 cycles

Indexed $\rightarrow$ IMR + IALU = 4+2 = cycles

Average execution time = [0.2 × 0 + 0.2×0+0.2×4 + 0.2 ×8 + 0.1 × 4 + 0.1 ×6] × 2nsec.

= [0.8 + 1.6 + 0.4 + 0.6] ×2nsec.

$= 3.4 \times 2$ nsec.

$= 6.8$ n sec.

7. (d)

For example.

Add A, @500 $\Rightarrow$ A $\leftarrow$ A + m [m[500]]

500	625
	⋮
625	400

Since 500 gives effective address (EA) of 400,

Hence, option (d) is true.

8. (10 to 10)

Number of registers = 19

Number of bits for register field $= \lceil \log_2 19 \rceil$

$= 5$

Addressing modes $= 10$

Number of bits for a addressing mode $= \lceil \log_2 10 \rceil$

$= 4$

RAM size $= 8k \times 32$

$= 2^{13} \times 2^{5}$

Address lines required = 13

Instruction size = 32 bits

Addressing Mode	Opcode Field	Registers	Memory address field
← 4 bits →	← x bits →	← 5 bits →	← 13 bits →

$4 + x + 5 + 13 = 32$

$x = 32 - 22$

$= 10$

9. (a, b, c, d)

Memory unit $= 256$ KW

$= 2^{18}$ W

1 word = 32 bits = 4B

Addressing mode = 2 bits for direct, indirect and registers.

Register code $= \lceil \log_2 64 \rceil = 6$ bits

Address lines in memory = 18 bits

Operation mode (op-code) $= 32 - (1 + 6 + 18)$

$= 32 - 25$

Opcode $= 7$ bits

10. (256 to 256)

The given data,

The CPU supports instruction size = 16 bits

Op-code field = 8 bits

Address size = 4 bits

← 16 bits →		
Op-code	Add_2	Add_1

We have two operands

so it requires the 2×4 bits = 8 bits

And remaining 16 – 8 bits can be used for two address instructions

Maximum number of two address instructions

$= 2^{8} = 256$

Branch : CSE & IT Hinglish

Weekly Test-03

Computer organization and Architecture

Floating point, Micro Operation, Micro program and Control unit

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. Assume the following floating-point format

Sign bit	Exponent	Mantisa

The E bits are formatted using excess 16 natation and the give contents are sign = 0, exponent = 10111 and mantissa = 1100100000

(a) 4 (b) 5
(c) 6 (d) 7

[MCQ]

2. Assume a 16 bit $(C4CC)_{16}$ represents floating data with excess-64(explicit normalization) then what is its decimal values ____?

(a) $(-12.75)_{10}$ (b) $(13.75)_{10}$
(c) $(12.85)_{10}$ (d) $(-13.85)_{10}$

[MCQ]

3. Consider the following statements.

S1: The exponent of a double Precision number contains more number of bits compared to exponent of a float.

S2. A double Precision can represent a floating-point number more accurately than a float.

(a) only S1 is true
(b) only S2 is true
(c) Both S1 and S2 are true
(d) Neither S1 nor S2 is true

[NAT]

4. The 2's compliment representation of a 16-bit number (out of 16 bits 1 bit is sign bit and 15 are magnitude) is FFFF. Its magnitude in decimal form will be represented is _______

[MCQ]

5. Match machine-instruction in List-I with respect to micro-instructions in list-II.

List-I	List-II
1. Load R1, a	P: MAR ← IR (operand address) MDR ← R1 Memory (MAR) ← MDR
2. Store a R1	Q: MAR ← IR (operand address) MDR ←Memory (MAR) R1← R1 + MDR
3. Add R1, a	R: MAR ← IR (operand address) MDR ←Memory (MAR) R1← MDR

Codes:

	1	2	3
(a)	P	Q	R
(b)	Q	R	P
(c)	R	P	Q
(d)	Q	P	R

Q.6 to 10 Carry TWO Mark Each

[MCQ]

6. A 16-bit register is used to store a floating data with excess 64 techniques then find

(i) Number of bits required for 'M' (Mantissa) field

(ii) Number of bits required for 'E' field

(iii) Represent $(-14.75)_{10}$ in the above register and express the values in hexa-decimal.

(a) 8, 7, $(C\ 4\ E\ C)_{10}$

(b) 7, 8, $(C\ 4\ E\ C)_{10}$

(c) 8, 7, $(C\ 4\ C\ C)_{10}$

(d) None of the above

[MCQ]

7. Consider the following hexadecimal form in the IEEE-754 single precision floating point number representation 0XC4EFC000, what is the value represented is represented by it?

(a) (–1900) (b) (–1915)

(c) (–1916) (d) (–1918)

[MCQ]

8. What will be the hexadecimal number of a decimal number 52.21875 in IEEE-754 single precision floating point system?

(a) 0×41230000 (b) 0×41200000

(c) $0 \times 42F77000$ (d) None of the above

[MSQ]

9. Choose the correct statement from the following.

(a) The values NaN is used to represent a value that is an error

(b) The result of $\pm 0 \div \pm 0$ is NaN(not a number).

(c) The result of $\pm$ infinity $\div \pm$ infinity is 0.

(d) The result of $\pm$ infinity $\times$ 0 is 0.

[MCQ]

10. Consider the following statements

S1: The minimum and maximum number that can be represented in sing magnitude for signed number is $-(2^{n-1} - 1)$ and $+ (2^{n-1} - 1)$

S2: The minimum and maximum number that can be represented in two's component for n bit signed number is $-(2^{n-1})$ and $+ (2^{n-1} - 1)$

(a) Only S1 is true (b) Only S2 is true

(c) Both S1 and S2 (d) Neither S1 nor S2 is true

Answer Key

1. (d)
2. (a)
3. (c)
4. (1)
5. (c)
6. (a)
7. (d)
8. (d)
9. (a, b)
10. (c)

Hints & Solutions

1. (d)

Exponent = $(10111)_2 = (23)_{10}$

Based exponent of the format = 23 – 16 = 7

2. (a)

S	E	M
1	1 0 0 0 1 0 0	1 1 0 0 1 1 0 0

$-0.110011 \times 2^{\pm e}$

-0.110011×2^{4}

-1100.11

$(-12.75)_{10}$

3. (c)

S1(true): In IEEE, exponents bits occupied by double precision are more than the float, hence this statement is true.

S2(true): As double precision has a greater number of bits than float, hence largest number can be more accurately represented.

4. (1)

2's compliment representation of FFFF = $(1111)_2$

$\underset{\text{sign bit}}{1}\,\underbrace{111\;\;1111\;\;1111\;\;1111}_{\text{magnitude bits in 2's compliment form}}$

Magnitude of 2's complement of 111111111111111 is $(000000000000001)_2 = (1)_{10}$

∴ 1 is correction answer.

5. (c)

Machine instruction	Micro-operation
1. Load R1, a	R: MAR ← IR (operand address) MDR ←Memory (MAR) R1← MDR
2. Store a R1	P: MAR ← IR (operand address) MDR ←R1 Memory(MAR) ← MDR
3. Add R1, a	Q: MAR ← IR (operand address) MDR ←Memory (MAR) R1← R1 + MDR

∴ option c is correct.

6. (a)

1. S + E + M = 16

1(sign) + E(Biased Exponent) + m = 16

1 + 7 + M = 16

M = 8

∴ Number of bits in M field is 8 bits.

2. NOTE: Biasing values is also known as excess values.

We know that

$b = 2^{k-1}$

$64 = 2^{k-1}$

Applying log on both sides

$6 = 2^{k-1}$

K = 7

Number of bits in E field is 7 bits.

3. –14.75

Sign bit = 1 (–)

14.75 =1 1 1 0. 1 1

Floating value = 1110.11×2^{0}

$0.\underbrace{111011}_{M \to 8\text{ bits}} \times 2^{4}$

1 1 1 0 1 1 0 0

So,

S	E		M	
1	1 0 0	0 1 0 0	1 1 1 0	1 1 0 0

$(C \quad 4 \quad E \quad C)_{16}$

$(C4EC)_{16}$

7. (d)

S	E	M
1	1 0 0 0 1 0 0 1	1 1 0 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Exponent = 137 – 127 = 10

∴ number will be

$-1.110111111 \times 2^{+10}$

$-1110111111 \times 2^{+10} \times 2^{-9}$

$= -959 \times 2$

$= -1918$

∴ D is correct

8. **(d)**
Given, $(52.21875)_{10} = (110100.00111)_2$
1.1010000111×2^5
Exponent = 5 + 127 = 132
Mantissa : 1010000111
Stored exponent = sign bit = 1
01000010010100001110000000000000
∴ 0 × 4250E000
∴ option (d) is correct.

9. **(a, b)**
(a) True: The value NaN is used to represent a value that is an error.
(b) True: The result of ± 0 ÷ ± 0 is NaN
(c) False : The result of ± infinity ÷ ± infinity is ± infinity
(d) False : The result of ± infinity × 0 is NaN.

10. **(c)**
We known that
The range of sign magnitude number is
$-(2^{n-1} - 1)$ to $+(2^{n-1} - 1)$
True: The range of two's components is
$-(2^{n-1})$ to $+(2^{n-1} - 1)$
∴ Option c is correct.

❑❑❑

Branch : CSE & IT Batch : Hinglish

WEEKLY TEST – 04

Computer Organization and Architecture

ALU and Control Unit

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. How many 256 × 8 memory modules are required to build 1G × 16 memory system______?

(a) 2^{24} (b) 2^{23}

(c) 2^{22} (d) 2^{21}

[MCQ]

2. Consider the following statements

S_1: Control unit directs the system and elevates the instruction entered by the user. It coordinates most of the operations in the computer.

S_2: ALU performs arithmetic, comparison and other operations. It executes all tasks to complete all those instructions.

(a) Only S_1 is true.
(b) Only S_2 is true.
(c) Both S_1 and S_2 are true.
(d) Neither S_1 and S_2 is true.

[MCQ]

3. Assume an instruction set architecture of a general propose machine has a total of 126 control signals. Then number of bits required in control word for horizonal and vertical micro-instruction encoding are?

(a) 7 in vertical and 126 in horizontal
(b) 126 in vertical and 7 in horizontal
(c) 128 in vertical and 7 in horizontal
(d) 7 in vertical and 128 in horizontal

[MCQ]

4. Consider the following sequence of micro-instructions.

I_1: MAR← PC
I_2: MBR← memory, PC← PC + 1
I_3: IR← (MBR)
I_4: MAR ←IR[Address field]
I_5: MBR ← (memory)
I_6: R1← R1 + (MBR)

What is the functionality of above instruction?

(a) Adding the number NUM to register R1.
(b) Adding the contents of memory location NUM to register R1
(c) Adding contents of the memory location whose address is at memory location NUM to register R1
(d) None of the above.

[MSQ]

5. Choose the correct statements form the following statements about horizontal and vertical micro programming.

(a) Horizontal micro programing is faster than vertical micro-programming
(b) In vertical programming, Additional hardware is required to generate control signals
(c) Vertical micro programming supports shorter control word and horizontal micro programming supports wider (longer) control word.
(d) Horizontal micro programming allows higher degree of parallelism than vertical micro programming.

Q.6 to 10 Carry TWO Mark Each

[NAT]

6. Consider a system with 6 register and 64 address and two types of 16– bit instruction. Type-1 instruction has three register operands and type-2 instruction has 1 address and 2 register operands. Both instructions exists and the encoding space is completely utilized then what is the total number of instructions can be possible in this system_________.

[MCQ]

7. Consider the following values are in memory and register R_1 is the index register and is stored with 200.

Address	400	500	600	700	800
Data	600	400	100	800	700

Let assume value loaded into the accumulator with instruction "load 500", is P if addressing mode considered to be immediate, if addressing mode considered to be direct addressing then the value of accumulator is q and with indirect addressing r is loaded into accumulator then the value of $x + y + z$ is_________.

(a) 1000 (b) 7000
(c) 1500 (d) 3000

[MCQ]

8. Consider the following code fragment

```
ADD R1, R0, #1          //R1←R0 + 1 and R0 = 0
ADD R2, R0, R0          //R2←R0 + R0
ADD R3, R0, #128        //R3←R0 + 128
Loop: MUL R1, R2, #2    //R1←R1 × 2
ADD R2, R2, #1          //R2←R2 + 1
BNE R2, R3, loop        // if R2 = R3 then exit
```

How many instructions are executed dynamically to complete the above code?

(a) 385 (b) 386
(c) 387 (d) None of the above

[MCQ]

9. Assume a control unit in which the control signals can be divided into the following mutually exclusive types?

Type-1: 23 control signals to activate gates that transfer data from register to the internal bus to the register.

Type-2: 20 control signals to activate gates that transfer data from register to the internal bus to the register.

Type-3: 32 control signals to specify ALU operations.

Type-4: 8 control signals to specify ALU operations.

Then, how many bits of control word can be optimized by using vertical and horizontal micro programming________.

(a) 60 (b) 61
(c) 64 (d) 65

10. [MCQ]

Assume a micro programmed control unit which supports 260 instructions, each instruction takes 10 micro-operations. 15 flags are supported and 62 control signal vertical micro programmed is used the what is the size of 4 control words? (in bytes)

(a) 8 (b) 9
(c) 10 (d) 11

Answer Key

1. **(b)**
2. **(c)**
3. **(a)**
4. **(b)**
5. **(a, b, c, d)**
6. **(121)**
7. **(c)**
8. **(c)**
9. **(d)**
10. **(d)**

Hints and Solutions

1. (b)

$$\frac{2^{30}\times 16}{256\times 8}=\frac{2^{30}\times 2}{2^{8}}=2^{23}$$

Hence, option (b) is correct.

2. (c)

S_1 (True) : Control unit direct the system and elevates the instruction entered by the user. It coordinates most of the operations in the computer.

S_2 (True) : ALU performs arithmetic, comparison and other operations. It executes all tasks to complete all those instructions.

3. (a)

In horizontal encoding 1 bit is used for each control signal hence it will require 126 control signals and in vertical encoding, 126 control signals can be encoded in $\lceil \log_2 126 \rceil = 7$ bits.

4. (b)

Micro instruction I_1, I_2 and I_3 are used to fetch the instruction Microinstruction I_4, I_5 and I_6 are used to execute the instruction

$$\left.\begin{aligned} I_1 &: MAR \leftarrow (PC) \\ I_2 &: MBR \leftarrow (Memory)\, PC \leftarrow (PC)+1 \\ I_3 &: IR \leftarrow (MBR) \end{aligned}\right\}\text{fetch cyle}$$

I_4 : MAR ←IR (address field)

I_5 : MAR ←(memory)//address field of IR updated from the MBR so the reference memory location is read.

I_6 : $R_1 \leftarrow R_1$ +(MRR)// The contents of R and MBR are added by the ALU.

∴ This is executing instruction ADD R1, x.

5. (a, b, c, d)

Type-1: 23 control signals to activate gates that transfer data from register to the internal bus to the register.

Type-2: 20 control signals to activate gates that transfer data from register to the internal bus to the register.

Type-3: 32 control signals to specify ALU operations.

Type-4: 8 control signals to specify ALU operations.

6. (121)

Bits for register = 2^3 = 3 bits

Bits for register = 2^6 = 6 bits

Type 1 → 7 bits		3 bits	3 bits	3 bits
	Opcode	R1	R2	R3
Type 2 → 4 bits		6 bits	3 bits	3 bits
	Opcode	Add	R1	R2

In order to have maximum instruction, we gave 1 instruction to type A so 15 instruction are with type-2 and type- 2 opcode is of only 4 bits and that type-1 is of 7 bits we have 3 extra bits.

So, $15 \times 2^3 + 1 = 121$ instructions

7. (c)

- When immediate addressing is used then the value of p in accumulator is 500.
- If direct addressing is used the value of q in accumulator is m [500] = 400
- If indirect addressing is used the value of r accumulator is @ [500] = 600.

∴ = 500

8. **(c)**

RO = 0

R1 = 0 + 1 , R1 = 1

R2 = 0 + 0 , R2 = 0

R3 = 0 + 128 = 128

R1 = 1 × 2 = 2

R2 = 0 + 1 = 1

R2 ≠ R3

1 ≠ 128 So, go to loop section and this loop runs 128 times for first time all 6 instructions are executed and after 6th time only 3 instructions are executed.

6 + 3 × 127 = 387

∴ Total number of instructions executed is 387.

9. **(d)**

Type-1: 23 control signals present So, 5 bits are enough.
Type-2: 20 control signals So, 5 bits are enough
Type-3: 32 control signals So, 5 bits are enough
Type-4: 8 control signals So, 3 bits are enough

Vertical microprograming:
In this we require = 5 + 5 + 5 + 3 = 18 bits
Horizontal microprograming:
23 + 20 + 32 + 8 = 83 bits
∴ By using vertical microprograming over horizontal microprograming 83 – 18 = 65 bits can be saved or optimized.

10. **(d)**

Flag	Control signal	word offset
4 bits	6 bits	

Number of bits for flag = $\lceil \log_2 15 \rceil$ = 4 bits number of bits for control signal = $\lceil \log_2 62 \rceil$ = 6 bits length of control word = flag + control signal + address.

Also, number of operations for 260 instructions

= 260×10 = 2600

So. Address field = $\lceil \log_2 2600 \rceil$ = 12 bits

∴ Size of 1 control word = 12 + 4 + 6 = 22 bits

for 4 control words = 4× 22 bits = 88 bits

$\Rightarrow \frac{88}{8} = 11$ bytes.

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 01
Database Management System

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[NAT]

1. From the given below characteristics, choose the number of characteristics of a primary key:

I. Minimal attribute
II. Unique
III. Non-Null
IV. Null
V. Duplicate values

[MSQ]

2. Choose the correct statement from the following.

(a) A functional dependency $X \rightarrow Y$ is trivial functional dependency if y is a subset of x.

(b) A functional dependency $X \rightarrow Y$ is trivial functional dependency if y is a proper superset of X.

(c) A functional dependency $X \rightarrow Y$ is called non-trivial functional dependency if Y is not a subset of X.

(d) A functional dependency $X \rightarrow Y$ is called non-trivial functional dependency if Y is proper subset of X.

[MCQ]

3. The candidate key other than primary key is called an ______.

(a) Super key (b) Foreign key
(c) Alternate key (d) None

[MCQ]

4. Choose the correct statement from the following regarding a composite key:

(a) Any key such as primary key, candidate key can be called composite key if it has more than one attribute.

(b) A super key can be called as a composite key if it has more than one attribute.

(c) A key that has more than one attribute is known as composite key.

(d) All the statement are true.

[MSQ]

5. Given a relation R (X, Y, Z, W, U, V) with (X, Z) and {W, U, V} as the only candidate keys, then choose the super keys for the given relation.

(a) {X, Z} (b) {X, Z, U}
(c) {X, Y} (d) {W, U, V}

Q.6 to 10 Carry TWO Marks Each

[NAT]

6. Given the following FD set over a relation R (A, B, C, D, E, F, G, H, I)

$\{A \rightarrow DE, D \rightarrow BCE, B \rightarrow AFI, AH \rightarrow GI\}$

The number of non-prime attributes for the above FD set is/are?

[MCQ]

7. Consider a relation R (P, Q, R, S, T, U) with the following functional dependencies:
$PQ \rightarrow R$, $S \rightarrow TU$, $R \rightarrow P$, $QT \rightarrow R$, $QR \rightarrow S$, $RU \rightarrow QS$, $PRS \rightarrow Q$, $RT \rightarrow PU$
Which of the following is/are true?
(a) The closure of QR is {P S T U}
(b) All attributes present in R are in the closure of QR
(c) QR is the only candidate key of R
(d) PQR is a key of R

[NAT]

8. Find the number of candidate keys possible for the given functional dependency set on relation
R (p, q, r, s, t, u, v)
$\{p \rightarrow qr, r \rightarrow st, s \rightarrow quvp\}$

[MCQ]

9. Consider a relation R(P, Q, R, S, T) and the set of functional dependency set $\{P \rightarrow ST, S \rightarrow Q,$ and $T \rightarrow R\}$ if we project R (and therefore its FD sets onto schema R_1 (P, Q, R). Then choose the correct option in the following?
(a) Only PQR is a Candidate key
(b) Only P is key
(c) Only ST is a key
(d) None of the above

[MSQ]

10. Consider relation R (P, Q, R, S, T, U) with following functional dependencies:
(i) $P \rightarrow Q$ (ii) $RS \rightarrow T$
(iii) $T \rightarrow P$ (iv) $Q \rightarrow S$
How many candidate keys does R have? ______.

Answer Key

1.	**(3)**	**6.**	**(5)**
2.	**(a, c)**	**7.**	**(b)**
3.	**(c)**	**8.**	**(3)**
4.	**(d)**	**9.**	**(b)**
5.	**(a, b, d)**	**10.**	**(4)**

Hints and Solutions

1. (3)

A primary key is a minimal set of attributes, that uniquely identify a tuple in a relation

A primary key is minimal, unique and allows no null values

2. (a, c)

A trivial functional dependency is of the form $X \rightarrow Y$ where $Y \subseteq X$

A non-trivial functional dependency is of the form $X \rightarrow Y$ where $Y \cap X = \phi$ or $Y \not\subset X$.

3. (c)

The candidate key other than the primary key is called an alternate key.

Example:

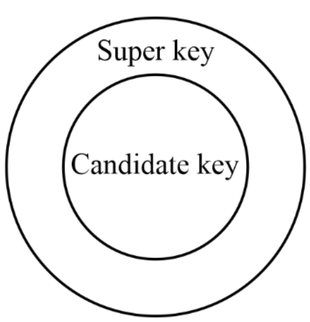
EMP_ID as well as EMP_PHNO both are candidate key for relation student but EMP_PHNO will be an alternate key.

4. (d)

Any key such as a primary key, candidate key, or super key can be called composite key if it has more than one attribute.

5. (a, b, d)

Every candidate key is a super key



As already mentioned in the question, there exists only 2 candidate keys for the given relation i.e. {X, Z} and {WUV}, then the super keys will be a combination of candidate key + other non-prime attributes.

So super keys are {X, Z}, {W, U, V}, and {X, Z, U}.

6. (5)

There exists 3 candidate keys for the given FD set:

A^+ = {A, D, E, B, C, F, I} ✕ not candidate key

AH^+ = {A, D, E, B, C, F, I, H, G} ✓ candidate key

BH^+ = {B, A, F, I, D, E, H, G, C} ✓ candidate key

DH^+ = {D, H, B, C, E, A, F, I, G} ✓ candidate key

Prime attribute = {A, B, D, H} = 4

So, non-prime attributes are 9 – 4 = 5.

7. (b)

(a) False, the closure of QR contains all the attributes.

(b) True, since QR^+ contains all the attributes. Therefore, it is candidate key of R.

(c) False, PQ is also a candidate key.

(d) False, since PQ is candidate key of R.

Therefore, PQR is super key of R.

8. (3)

Candidate key's p^+ = {p, q, r, s, t, u, v}

s^+ = {s, q, u, v, p, r, t}

r^+ = {r, s, t, q, u, v, p}

$qtuv^+$ = {q, t, u, v} ✕

Only 3 candidate key's possible.

9. (b)

P is not present in RHS of any FD. So P must be the part of a candidate key. So we check/validate it from taking closure of $P(P^+)$.

P^+ = {P, Q, R, S, T}

Closure of P contain all the attributes of the relation thus P is the only key

Hence option (b) is correct.

10. (4)

$P \rightarrow Q$

$RS \rightarrow T$

$T \rightarrow P$

$Q \rightarrow S$

$(P\ R\ U)^+ = \{P, Q, R, S, T\ U\}$

$(Q\ R\ U)^+ = \{P, Q, R, S, T\ U\}$

$(S\ R\ U)^+ = \{P, Q, R, S, T\ U\}$

$(T\ R\ U)^+ = \{P, Q, R, S, T\ U\}$

Hence there are 4 candidate keys

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 02

Subject : DBMS

Topic : Minimal Cover, Properties of Decomposition & Normal Form

Maximum Marks 20

Q.1 to 6 Carry ONE Mark Each

[MSQ]

1. Given a relational schema R(p q r s t) with FD set:
pq → r
s → t
Then choose the correct statement for the given FD set.
(a) R is in 2NF.
(b) R is not in 2NF.
(c) R is in 3NF
(d) R is not in 3NF

[MSQ]

2. Choose the correct statement from the following.
(a) If a relation is in 3NF then it is also in BCNF.
(b) If a relation is in 2NF then it is also in 3NF.
(c) If a relation is in BCNF then it is also in 3NF.
(d) If a relation is in BCNF then it is also in 2NF.

[MCQ]

3. Find the minimal cover for the FD set
F ={X → Y, XY → Z, W → XZ, W → U}
on a relation R (X, Y, Z, W, U)
(a) {X → Y, W → X, W → U}
(b) {X → Z, W → X, W→U}
(c) {X → Y, X → Z, W → X, W → U}
(d) {X → W, W → X, W → U}

[MSQ]

4. Consider the given FD set on relation R(x, y, z, w, v)
FD: {xy → z, z → w, w → y, w → v}
Then choose the correct statement from the following.
(a) R is in 2NF
(b) R is not in 3NF
(c) R is in BCNF
(d) R is not in BCNF

[MCQ]

5. Consider the given relation R(A B C D E F) with FD set as:
{A → CD, B → AC, D → EF, E → FB}
The given relation R satisfies which normal form?
(a) 1NF (b) 2NF
(c) 3NF (d) BCNF

[MCQ]

6. Consider the given set of FD set on relation R(p q r s t u v x)
{p →qr, r → uv, u → pxs, s → t}
The given relation R satisfies which normal form (Highest normal form).
(a) 1NF (b) 2NF
(c) 3NF (d) BCNF

Q.7 to 13 Carry TWO Mark Each

[MCQ]

7. Consider a relational schema R (P Q S T U V X Y Z W) Then what will be the maximum number of candidate keys possible for the above relational schema R?
(a) 10
(b) 20
(c) 252
(d) Not possible to find candidate keys.

[NAT]

8. Find the number of candidate keys for the given relation R (A B C D E F G) with FD set:
{AB → C, D → AB, C → DF, F → EG}

[MCQ]

9. Given a relational schema R(A, B, C, D, E) will set of functional dependencies P and Q as:
P:{A → B, AB → C, D → AC, D → E}
Q: {A → BC, D → AE}
Then choose the correct options from the following.
(a) Q is a subset of P
(b) P is a subset of Q
(c) $P \cong Q$
(d) $P \ncong Q$

[MSQ]

10. Choose the incorrect statements from the following:
(a) There can be atmost one primary key for any relation.
(b) There can be exactly one primary key for any relation
(c) There can exists 0 or more minimal cover for a given FD set for any relation.
(d) There exists only one minimal cover for a given FD set for any relation.

[MCQ]

11. Find the canonical cover for the FD set:
{Y → X, XW → YZ, Z → XYW}
On relation R(X, Y, Z, W)
(a) {Y → X, XW → Z, Z → YW}
(b) {Y → X, XW → Y, Z → YW}
(c) {Y → X, XW → Y, Z → XY}
(d) {Y → X, XW → Z, Z → YX}

[MSQ]

12. Choose the correct statement regarding normal forms from the following.
(a) If there exists only two attributes in a relation then it is in BCNF.
(b) If all the attributes are prime in a relation then the relation is in 3NF but may not be in BCNF.
(c) There exists 0 redundancy in 3NF always.
(d) None of the above.

[NAT]

13. The number of statement that is/are correct?
I: There exist 0% redundancy in third normal form (3NF).
II: There exist 0% redundancy in Boyce codd normal form (BCNF).
III: There should not exist any partial dependency in second normal form (2NF).

Answer Key

1. (b, d)
2. (c, d)
3. (c)
4. (b, d)
5. (d)
6. (b)
7. (c)
8. (3)
9. (c)
10. (b, d)
11. (a)
12. (a, b)
13. (2)

Hints and Solutions

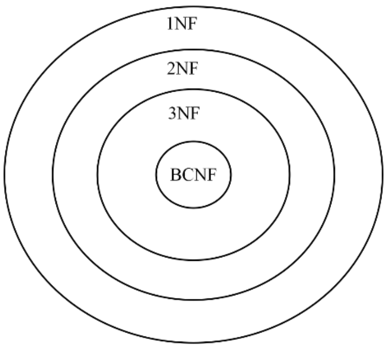
1. (b, d)

Given FD set :{pq →r, s → t}The candidate key for relation R is pqs.

$pqs^+ = \{p\ q\ r\ s\ t\}$

As there exists partial dependency, the relation R is not in 2NF and in turn not in 3 NF.

2. (c, d)



3. (c)

1. $X \to Y$
2. $XY \to Z$
3. $W \to XZ$
4. $W \to U$

As Y is implied by X, therfore Y is an entraneous attribute in $XY \to Z$, so updated FD $\Rightarrow X \to Z$.

1. $X \to Y$
2. $X \to Z$
3. $W \to X$
4. $W \to Z$
5. $W \to U$

In 4, $W \to Z$, is a redundant FD

So, Finally: $X \to Y$

$X \to Z$

$W \to X$

$W \to U$

$$\text{Minimal cover} = \begin{Bmatrix} X \to Y, & W \to X \\ X \to Z, & W \to U \end{Bmatrix}$$

4. (b, d)

The candidate key for relation R

$xy^+ = \{x, y, z, w, v\}$

$xz^+ = \{x, z, w, y, v\}$

$xw^+ = \{x, w, y, v, z\}$

$xv^+ = \{x, v\}$

	xy → z	z → w	w → y	w → v
2NF	✓	✓	✓	×
3NF	✓	✓	✓	×
BCNF	✓	×	×	×

Candidate keys: {xy, xz, xw}

Prime attributes: {x, y, z, w}

The given relation is in 1NF.

5. (d)

$\{A \to CD, B \to AC, D \to EF, E \to FB\}$

Candidate keys for relation R are:

$A^+ = \{A, C, D, E, F, B\}$

$B^+ = \{B, A, C, D, E, F\}$

$C^+ = \{C\}$

$D^+ = \{D, E, F, B, A, C\}$

$E^+ = \{E, F, B, A, C, D\}$

$F^+ = \{F\}$

$CF^+ = \{C, F\}$

Candidate keys are: {A, B, D, E}

	A → CD	B → AC	D → EF	E → FB
2NF	✓	✓	✓	✓
3NF	✓	✓	✓	✓
BCNF	✓	✓	✓	✓

6. (b)

Given FD set:

{p →qr r → uv u → pxs s → t}

Candidate keys:

$p^+ = \{p, q, r, u, v, x, s, t\}$

$r^+ = \{r, u, v, p, x, s, t, q\}$

$u^+ = \{u, p, x, s, t, q, r, v\}$

$s^+ = \{s, t\}$.

prime attributes = {p, r, u}

	p → qr	r → uv	u → pxs	s → t
2NF	✓	✓	✓	✓
3NF	✓	✓	✓	×
BCNF	✓	✓	✓	×

Hence, the highest normal form is 2NF.

7. **(252)**

For any relational instance with "n" attributes we get the maximum number of candidate keys if we group 2 attributes together.

Therefore selecting 2 attributes set from n attributes

$${}^{n}C_{\left\lfloor \frac{n}{2} \right\rfloor} \Rightarrow {}^{10}C_{\left\lfloor \frac{10}{2} \right\rfloor} \Rightarrow {}^{10}C_5$$

$$\Rightarrow \frac{{}^{2}\cancel{10} \times 9 \times \overset{2}{\cancel{3}} \times 7 \times \cancel{6} \times \cancel{5!}}{\cancel{5!} \times \cancel{5} \times \cancel{4} \times \cancel{3} \times \cancel{2} \times 1}$$

$\Rightarrow 4 \times 9 \times 7$

$\Rightarrow 36 \times 7 = 252$

8. **(3)**

$A^+ = \{A\}$

$B^+ = \{B\}$

$C^+ = \{C, D, F, A, B, E, G\}$

$D^+ = \{D, A, B, C, F, E, G\}$

$E^+ = \{E\}$

$F^+ = \{F, E, G\}$

$AB^+ = \{A, B, C, D, E, F, G\}$

Only 3 candidate keys possible for R i.e {C, D, AB}

9. **(c)**

Let's first find attribute closure of L.H. S of FD set Q in FD set P

$A^+ = \{A, \underline{B}, \underline{C}\}$ ✓ $[A \to BC]$ in Q.

$D^+ = \{D, \underline{E}, \underline{A}, C, B\}$ ✓ $[D \to AE]$ in Q.

So, $Q \subseteq P$

Now checking the attribute closure of L.H.S of FD set P in FD set Q.

$A^+ = \{A, B, C\}$ ✓ $[A \to B]$ in P

$AB^+ = \{A, B, C\}$ ✓ $[A \to BC]$ in P

$D^+ = \{\underline{D}, \underline{A}, E, B, \underline{C}\}$ ✓ $[D \to AC]$ in P

$[D \to E]$ in P

So, $P \subseteq Q$

We can conclude that $P \cong Q$. So option (c) is correct.

10. **(b, d)**

There exists at most one primary key for any relation.

There can be 0 or more minimal cover for any given FD set for a relation.

11. **(a)**

(1) Y → X

XW → YZ

Z → XYW No extraneous attribute

(2) Y → X

XW → Y, Redundant FD

XW → Z Removing redundant FD's.

Z → X, Redundant FD

Z → Y

Z → W

(3) Y → X

XW → Z Applying merging rule on RHS.

Z → Y

Z → W

Resultant FD: {Y → X, XW → Z, Z → YW}

12. **(a, b)**

If there exists only two attributes in a relation then it is always in BCNF.

If all the attributes are prime in a relation, then the relation is in 3NF always because for satisfying 3NF.

For FD X → Y:

Either X should be a super key or Y should be a prime attribute.

13. **(2)**

There may be redundancy in 3NF while there exists no redundancy in BCNF. The second normal form does not allow any partial dependency.

So statement II and III are correct.

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 03

Subject : Database Management System

Topic : Normal Form and Serializability

Maximum Marks 12

Q.1 to 4 Carry ONE Mark Each

[MCQ]

1. Consider the relation R(ABCDE) with the following set of functional dependencies (FD's)

F: {AB→C, C→D, D→E, E→A, D→B}

The which of the following Highest Normal form satisfied by the above relation R?

(a) BCNF (b) 3NF
(c) 2NF (d) 1NF

[MSQ]

2. Consider the following relation with given functional dependencies.

A (R, S, T, U, V)

FD's: {RS→T, RS→U, U→R, ST→U, ST→ V}

Then Relation is in which Normal Form?

(a) 1NF (b) 2NF
(c) 3NF (d) BCNF

3. [NAT]

Consider 3 transactions T_1, T_2 and T_3 having 2, 3 and 4 operations respectively.

The total number of non-serial schedule is_______.

[MSQ]

4. Consider the following schedule:

S1: $r_1(x)$ $w_2(x)$ $w_1(x)$ $w_3(x)$ $r_3(x)$

S2: $r_1(x)$ $w_2(x)$ $w_3(x)$ $w_1(x)$ $r_3(x)$

Which of the following is correct about the Schedule S?

(a) S_1 is conflict serializable.
(b) S_1 is not conflict serializable.
(c) S_2 is conflict serializable.
(d) S_2 is not conflict serializable.

Q.5 to 8 Carry TWO Mark Each

5. [NAT]

Consider the following Relation:

R(ABCDEFGH) with FD set of Relation R {A→B, C→D, E→FGH} what is the minimum number of relations required to decompose into BCNF which satisfy lossless join and Dependency preserving decomposition ________.

6. [MSQ]

Consider the following two schedules S_1 and S_2 involving three transactions T_1, T_2 and T_3 as:

S_1: $R_2(x)W_1(y)W_1(z)$ $R_1(w)$ $R_3(y)$ $R_2(y)$ $R_1(x)$ $R_3(w)$ $R_2(z)$ $W_3(x)$ $R_2(w)$ $W_1(x)$

S_2: $R_1(x)$ $R_3(w)$ $W_1(y)$ $W_1(z)$ $R_1(w)$ $W_3(y)$ $R_3(y)$ $R_2(y)$ $R_2(x)$ $R_2(z)$ $R_2(w)$

Which of the following options is/are correct regarding the above two schedules S_1 and S_2?

(a) S_1 is conflict serializable.
(b) S_1 is not conflict serializable.
(c) S_2 is conflict serializable.
(d) S_2 is not conflict serializable.

7. [NAT]

Consider the following relational schema with given FD's

Schema I: R(ABCD) and FD's are [AB → C, C→ D, D → A]

Schema II: R(ABCDE) and FD's are [$AB \rightarrow C$, $C \rightarrow D$, $D \rightarrow B$, $D \rightarrow E$]

Schema III: R(ABCDE) and FD's are [$A \rightarrow B$, $B \rightarrow C$, $C \rightarrow D$, $D \rightarrow E$, $D \rightarrow A$]

Schema IV: R(ABCDE) and FD's are [$B \rightarrow C$, $B \rightarrow D$, $D \rightarrow E$]

How many above schema satisfy the third normal form (3NF) is________?

8. [MSQ]

Consider the relation R(ABCDE) with the following set of functional dependencies

F: [$A \rightarrow D$, $AB \rightarrow C$, $AD \rightarrow CE$, $B \rightarrow C$, $D \rightarrow A$, $D \rightarrow B$]

Then which of the following is/are True for R?

(a) R is in 1NF
(b) R is in 2NF
(c) R is in 3NF
(d) R is Not is 3NF & Not in BCNF

Answer Key

1. **(b)**
2. **(a, b, c)**
3. **(1254)**
4. **(b, d)**
5. **(4)**
6. **(b, c)**
7. **(2)**
8. **(a, b, d)**

Hints and Solutions

1. (b)

F:{AB→C, C→D, D→E, E→A, D→B}

Candidate keys = [AB, EB, C, D]

Prime / key Attribute = [A, B, C, D, E]

Here all attribute of relation R is key/prime attribute.

So R is in 3NF

Here R is not in BCNF because in FD

E→A: E is not super key.

So R is in 1NF, 2NF and 3NF.

So highest normal form satisfy is 3NF.

2. (a, b, c)

FD's: {RS→T, RS→U, U→R, ST→U, ST→V}

In this question candidate keys = [RS, SU, ST]

In the FD U→R, U is not a super key.

So Relation is Not in BCNF but in 3NF.

So, this relation is in 1NF, 2NF & 3NF also.

3. (1254)

3 Transaction T_1: 2 operation (n_1)

T_2: 3 operation (n_2)

T_3: 4 operation (n_3)

Total number of Concurrent Schedule

$$= \frac{(n_1 + n_2 + n_3)!}{(n_1!)(n_2!)(n_3!)}$$

$$= \frac{(2+3+4)!}{(2!)(3!)(4!)} = \frac{9!}{2\times 6\times 4!}$$

$$= \frac{9\times 8\times 7\times 6\times 5\times 4!}{2\times 6\times 4!}$$

$\boxed{\text{Total No. of Concurrent Schedule} = 1260}$

Total No. of serial schedule = 3! = 6 Serial Schedule.

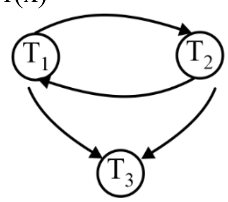
Total Number of = 1260 – 6

Non-Serial Schedule = 1254

4. (b, d)

Schedule: S1

T_1	T_2	T_3
r(x)		
	w(x)	
w(x)		
		w(x)
		r(x)



Cycle exists, therefore S1 not conflict serializable.

Schedule S2: S2 is also not conflict serializable as precedence graph contains cycle.

5. (4)

R (ABCDEFG) {A→B, C→D, E→FGH]

Candidate key = [ACE]

Check BCNF = ?

A→B, C→D, E→FGH} violates BCNF

Because <u>x</u>→y : x is Not super key

So, R Not in BCNF.

BCNF Deconposition

R_1(AB) R_2 (CD) R_3 (EFGH) R_4 (ACE)

Now its in BCNF + losseless join + Dependency Preserving.

6. (b, c)

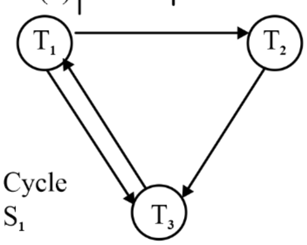
Sol.

S_1: $R_2(x)W_1(y)W_1(z)$ $R_1(w)$ $R_3(y)$ $R_2(y)$ $R_1(x)$ $R_3(w)$ $R_2(z)$ $W_3(x)$ $R_2(w)$ $W_1(x)$

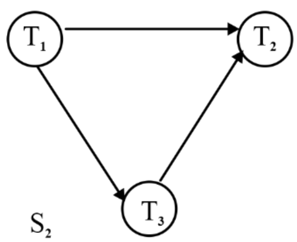
S_2: $R_1(x)$ $R_3(w)$ $W_1(y)$ $W_1(z)$ $R_1(w)$ $W_3(y)$ $R_3(y)$ $R_2(y)$ $R_2(x)$ $R_2(z)$ $R_2(w)$

T_1	T_2	T_3
	R(x)	
W(y)		
W(z)		
R(w)		
		R(y)
	R(y)	
R(x)		
		R(w)
	R(z)	
		W(x)
	R(w)	
W(x)		

T_1	T_2	T_3
R(x)		
		R(w)
W(y)		
W(z)		
R(w)		
		W(y)
		R(y)
	R(y)	
	R(x)	
	R(z)	
	R(w)	



Cycle
S_1
Not conflict Serializable



S_2
Conflict Serializable
$\langle T_1\ T_3\ T_2 \rangle$

7. (2)

Schema I: R(ABCD) and FD's are [AB → C, C→ D, D → A]

Candidate keys = [AB, DB, CB]

Relation R is in INF, 2NF & 3NF But Not in BCNF because C → D, D → A violate BCNF definition.

Schema II: R(ABCDE) and FD's are [AB → C, C→ D, D → B, D → E]

Candidate keys = [AB, AD, AC]

Here D → E is a Partial Dependency so R Not in 2NF.

Schema III: R(ABCDE) and FD's are [A → B, B→ C, C → D, D → E, D → A]

Candidate key = [A, B, C, B]

Here in every Non Trivial FD x→ y, x [determinant] is a supper key so R is in BCNF & 3NF.

Schema IV: R(ABCDE) and FD's are [B → C, B→ D, D → E]

Candidate key = [AB]

Here B → C & B → D is a Partial Dependency. So R Not in 2NF.

So, Schema I & Schema III Satisfy 3NF.

8. (a, b, d)

R(ABCDE) {A → D, AB → C, AD → CE, B → C, D → A, D → B}

$(A)^+ = (ADBCE)$

A is Candidate key ……(1)

D → A

$(D)^+ = (ABCDE)$

D is candidate key ……(2)

Candidate keys = [A, D]

Check 2NF? No Partial Dependency, ∴ R is in 2NF

Check 3NF? B→C; Non key/ → Non key Attribute; Non Prime Attribute — Voilate 3NF

OR

B→C B is Not super key or C is Non key Attribute

So, R is in 2NF But Not in 3NF & Not in BCNF

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 04

Subject : Database Management System

Topic : Transaction & Concurrency Control

Maximum Marks 20

Q.1 to 6 Carry ONE Mark Each

[MCQ]

1. The application programmer is responsible to ensure which of the following properties?

(a) Atomicity
(b) Consistency
(c) Isolation
(d) Durability

[MSQ]

2. Which of the following scenarios may not lead to an irrecoverable schedule?

(a) A transaction performs write on a data item after it is read by an uncommitted transaction.
(b) A transaction reads a data item after it is written by an uncommitted transaction.
(c) A transaction reads a data item after it is read by an uncommitted transaction.
(d) A transaction reads a data item after it is written by a committed transaction.

[MSQ]

3. Choose the correct statements from the following.

(a) View serializability is a necessary and sufficient condition for serializability testing.
(b) Conflict serializability is sufficient but not necessary condition.
(c) Testing of conflict serializability is a polynomial problem.
(d) All the statements are true.

[MSQ]

4. Consider the following schedule using three transactions T_1, T_2 and T_3

T_1	T_2	T_3
R(x)		
	R(y)	
		R(y)
W(x)		
		W(x)
	R(x)	
	W(x)	

Then which of the schedule below is not the correct serialization of the above?

(a) $T_2 \rightarrow T_1 \rightarrow T_3$ (b) $T_2 \rightarrow T_3 \rightarrow T_1$
(c) $T_1 \rightarrow T_3 \rightarrow T_2$ (d) $T_3 \rightarrow T_1 \rightarrow T_2$

[MCQ]

5. Choose the correct statement from the following for schedule S given below:

T_1	T_2
R(A)	
	R(B)
W(A)	
	R(A)
	W(A)
	W(B)
R(B)	
W(B)	

(a) Schedule S is conflict serializable.
(b) Schedule S is view serializable.
(c) Schedule S is not serializable
(d) None of the above.

[MCQ]

6. Amongst the ACID properties of a transaction, the _____ property requires that the changes made to the database by a successful transaction always persist.

(a) Atomicity (b) Consistency

(c) Isolation (d) Durability

Q.7 to 13 Carry TWO Mark Each

[NAT]

7. Consider given two schedules:

S_1: $r_1(x)\ r_1(y)\ r_2(x)\ r_2(y)\ w_2(y)\ w_1(x)$

S_2: $r_1(x),\ r_2(x),\ r_2(y)\ w_2(y)\ r_1(y)\ w_1(x)$.

The number of schedules that is/are conflict serializable are?

[NAT]

8. Consider the given transactions:

T_1: $w_3(A)\ w_3(B)$

T_2: $r_2(A)\ r_2(B)$

T_3: $r_1(A)\ w_1(A)\ r_1(B)\ w_1(B)$

The number of concurrent schedules between T_1, T_2 and T_3 is / are ______that are non-serial.

[NAT]

9. How many view equivalent serial schedules are possible for the below schedule:

S: $w_1(A)\ r_2(A)\ w_3(A)\ r_4(A)\ w_5(A)$

[NAT]

10. Consider the following schedule:

S: $r_1(x)\ w_1(y)\ r_2(x)\ w_2(y)\ r_3(x)\ w_3(y)$

The number of conflict equivalent schedules is/are______.

[MCQ]

11. Consider the following schedule:

S: $r_1(A)\ r_2(B)\ r_3(C)\ r_1(B),\ r_2(C),\ r_3(A)$
$w_1(A)\ w_2(B)\ w_3(C)$

Choose the correct statements for the above schedule S.

(a) S is conflict serializable as $T_1 \rightarrow T_2 \rightarrow T_3$.

(b) There exist 30 conflict equal serial schedules for S.

(c) S is not conflict serializable schedule.

(d) None of these.

[NAT]

12. Consider given schedule:

S: $r_1(x),\ r_2(y),\ w_3(y),\ r_4(x),\ w_4(z),\ w_3(y)$

How many conflict serializable schedules exists for the above schedule S?

[MSQ]

13. Consider the given schedule S as follows:

S: $r_1(x)\ w_2(x)\ w_1(x)$, commit 2, commit 1.

Choose the correct statements regarding above.

(a) S is a recoverable schedule.

(b) S is conflict serializable.

(c) S is view serializable.

(d) S is not serializable.

Answer Key

1. (b)
2. (a, c, d)
3. (a, b, c, d)
4. (a, b, d)
5. (c)
6. (d)
7. (1)
8. (414)
9. (2)
10. (15)
11. (c)
12. (12)
13. (a, d)

Hints and Solutions

1. (b)

The application programmer or user is responsible to ensure the consistency property for any transaction.

Atomicity and Durability are ensured by the recovery management component of DBMS software. While isolation is taken care by the concurrency controller of DBMD software.

2. (a, c, d)

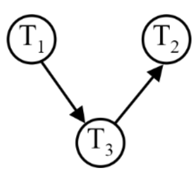
A transaction is said to be irrecoverable if it reads a data item after that data item is written by an uncommitted transaction.

3. (a, b, c, d)

Conflict serializability is a sufficient but not necessary condition views serializability is both necessary and sufficient testing of conflict serializability is dense in polynomial time.

4. (a, b, d)

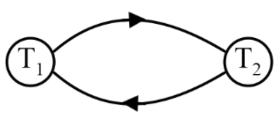
Checking for conflict serializability using precedence graph



Conflict serial schedule = $T_1 \rightarrow T_3 \rightarrow T_2$

5. (c)

If we check for precedence graph of S:



There exists cycle in precedence graph hence it is not conflict serializable.

Also need to check for no blind write present, therefore no view serializable.

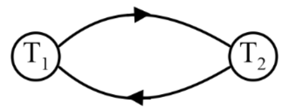
The schedule S is not serializable.

6. (d)

Durability property requires that the changes made to the database by a successful transaction should always persist, even if there is a failure of any blind.

7. (1)

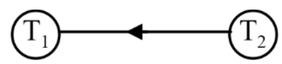
Precedence graph for S_1:



Cycle in precedence graph

$\therefore$ not conflict serializable.

Precedence graph for S_2:



No cycle in precedence graph

$\therefore$ S_2 is serializable as $T_2 \rightarrow T_1$.

Between S_1 and S_2 only S_2 is conflict serializable.

8. (414)

Number of concurrent schedules = $\frac{(n+m+k)!}{n!m!k!}$

Where n, m, and R are operations in transactions T_1, T_2, and T_3 respectively.

$n = 2, m = 2, k = 4$

$$\frac{(n+m+k)!}{n!m!k!} = \frac{8!}{2!2!4!}$$

$$= \frac{{}^{4}\cancel{8} \times 7 \times \cancel{6}^{3} \times 5 \times \cancel{4}!}{\cancel{4}! \times \cancel{2} \times \cancel{2}}$$

$= 20 \times 21$

$= 420$

Number of non-serial schedules = 420 – 3!

420 – 6 = 414

9. (2)

T_1	T_2	T_3	T_4	T_5
w(A)				
	r(A)			
		w(A)		
			r(A)	
				w(A)

Initial read: ____

Updated read: $T_1 \rightarrow T_2$ and $T_3 \rightarrow T_4$

Final write: T_5

- The view equal serial schedule will have T_5 fixed at the end

  _ _ _ _ _ T_5
- Also, $T_1 \rightarrow T_2$ and $T_3 \rightarrow T_4$ is also fixed to preserve updated read property

  However, $T_1 \rightarrow T_2$ and $T_3 \rightarrow T_4$ can be arranged in 2 ways
- The view equal serial schedules will be:

  $T_1 \rightarrow T_2 \rightarrow T_3 \rightarrow T_4 \rightarrow T_5$

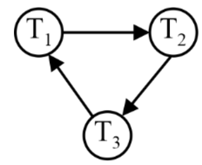
  $T_3 \rightarrow T_4 \rightarrow T_1 \rightarrow T_2 \rightarrow T_5$

10. (15)

There exists conflict for all the write operations, so their order cannot be changed.
Read operations have no conflict.
______ $w_1(y)$ ______ $w_2(y)$ ______ $w_3(y)$
read on x by T_1 will be left of $w_1(y)$ so,
______r_1 ______$w_1(y)$ ______$w_2(y)$ ______$w_3(y)$
Now r_2 can go to any of the 3 places left of $w_2(y)$, so.
______r_1 ______w_1 ______r_2 ______w_2 ______w_3
Now r_3 can go to any of the 5 places left of $w_3(y)$. so, total conflict equivalent.
Schedule $\Rightarrow 3 \times 5 = 15$.

11. (c)

T_1	T_2	T_3
r(A)		
	r(B)	
		r(C)
r(B)		
	r(C)	
		r(A)
w(A)		
	w(B)	
		w(C)

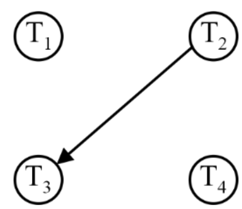


The schedule S is not conflict serializable.

12. (12)

T_1	T_2	T_3	T_4
r(x)			
	r(y)		
		w(y)	
			r(x)
			w(z)
		w(y)	

Checking for the precedence graph.



That means only constraint is T_2 should execute before T_3 while T_1 and T_4 can execute in any order.

$(T_2 \rightarrow T_3)$

______T_2 ______T3 ______.

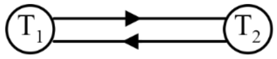
Both T_1 and T_4 can be in any of the 3 places. Therefore 3!

Also T_1 and T_4 execute any order therefore 2!. So, total conflict serializable schedule $\Rightarrow 3! \times 2! = 12$.

13. (a, d)

T_1	T_2
r(x)	
	$w_2(x)$
$w_1(x)$	
	commit
commit	

There exists no dirty read, therefore the schedule S is recoverable schedule



There exists cycle in precedence graph therefore it is not conflict serializable.

Now, check for view serializability:

Initial read: $T_1 \rightarrow T_2$

Updated read: ___

Final write $T_2 \rightarrow T_1$

Thus, for the given schedule no equivalent serial schedule possibole. Hence, schedule is not serializable.

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 05

Subject : Database Management System

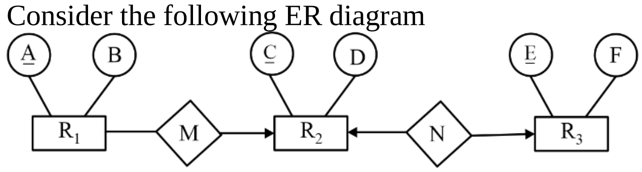
Topic : ER Model and Locking protocols

Maximum Marks 16

Q.1 to 6 Carry ONE Mark Each

[MCQ]

1. Consider the following ER diagram



The minimum number of tables needed to represent M, N, R_1, R_2, R_3 is _________

(a) 4 (b) 3
(c) 2 (d) None

[MCQ]

2. Conflict serialization is NOT satisfied by –

(a) Basic 2PL Protocol.
(b) Thomas Write Time Stamp Ordering Protocol.
(c) Basic Time Stamp Ordering Protocol.
(d) Strict 2PL Protocol.

[MCQ]

3. Consider the following statements:

P: Time Stamp Ordering Protocols are always free from deadlock.
Q: Two-phase Locking Protocols are always free from deadlock.

Which of the following statements is/are CORRECT?

(a) P only (b) Q only
(c) Both P and Q (d) Neither P nor Q

[MCQ]

4. Consider the following statements about basic ER and relational models –

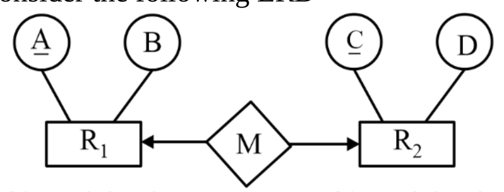
P: An attribute of an entity can be composite.
Q: An attribute cannot have more than one value in a tuple of relational table.

Which of the above statement(s) is/are CORRECT?

(a) P only (b) Q only
(c) Both P and Q (d) Neither P nor Q.

[MCQ]

5. Consider the following ERD –



70% participation 30% participation

I: R_1 M ($\underline{A}$ B C), R_2 ($\underline{C}$ D)

II: R_2 M ($\underline{C}$ D A), R_1 ($\underline{A}$ B)

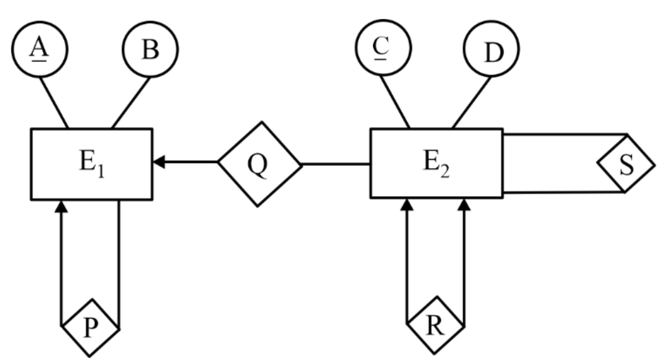
III: R_1 R_2 M ($\underline{A}$ B C D)

Among the given statements I, II and III, then incorrect solutions are ___

(a) I only
(b) II and III only
(c) III only
(d) I and II

[NAT]

6. Consider the following ERD –

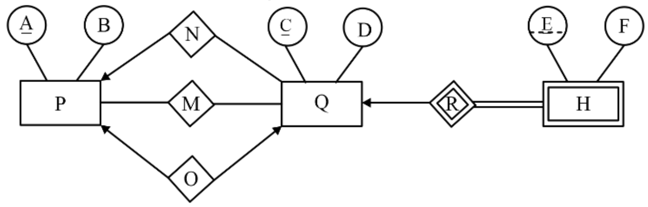


Let X is the total number of attributes and Y is number of foreign keys in the minimum relational design, then X + 2Y is _________.

Q.7 to 11 Carry TWO Marks Each

[NAT]

7. Consider the following ERD –



The minimum number of tables required to represent the above ERD is __________.

[MCQ]

8. Consider the following two schedules –

S_1: $R_1(X)\ R_3(Y)\ W_1(X)\ W_2(X)\ W_2(Y)\ W_1(Z)\ R_3(Z)$

S_2: $R_1(X)\ R_2(Y)\ W_1(X)\ W_3(X)\ W_3(Y)\ W_1(Z)\ R_2(Z)$

Which of the above given schedules are NOT allowed by Basic Time Stamp Ordering Protocol?

(Assume timestamps, $T_1 = 5$, $T_2 = 10$, $T_3 = 15$)

(a) S_1 only

(b) S_2 only

(c) Both S_1 and S_2

(d) Neither S_1 nor S_2

[MCQ]

9. Consider the following two schedules –

S_1: $W_2(X)\ W_1(X)\ W_3(X)\ W_2(Y)\ W_1(Y)\ W_3(Y)$

S_2: $W_1(X)\ W_2(X)\ W_3(X)\ W_1(Y)\ W_2(Y)\ W_3(Y)$

Which of the following is/are correct?

(a) S_1 is allowed by 2PL

(b) S_2 is allowed by 2PL

(c) S_1 and S_2 both are allowed by 2Pl

(d) Neither S_2 nor S_2 are allowed by 2PL

[MCQ]

10. Consider the following schedule-

S: $R_2(X)W_3(X)W_1(X)W_2(Y)R_2(Z)R_4(X)R_4(Y)$

Which of the following statements is correct?

(a) S is conflict serializable and allowed by 2PL

(b) S is conflict serializable and not allowed by 2PL

(c) S is not conflict serializable and allowed by 2PL

(d) S is not conflict serializable and not allowed by 2PL.

[MSQ]

11. Consider the following Schedule:

$r_1(x)\ r_2(y)\ r_2(x)\ w_1(z)\ r_1(y)\ w_3(y)\ r_3(z)\ w_2(y)\ w_3(x)$

which of the following time stamp ordering Not allows to execute schedule using Thomas Write rule time stamp Ordering Protocol?

(a) $(T_1, T_2, T_3) = (20, 30, 10)$

(b) $(T_1, T_2, T_3) = (10, 20, 30)$

(c) $(T_1, T_2, T_3) = (10, 30, 20)$

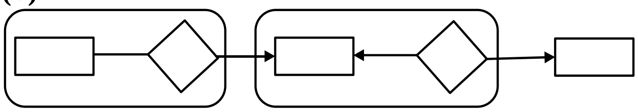
(d) $(T_1, T_2, T_3) = (30, 20, 10)$

Answer Key

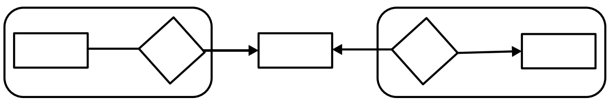
1. **(b)**
2. **(b)**
3. **(a)**
4. **(c)**
5. **(b)**
6. **(19)**
7. **(4)**
8. **(a)**
9. **(d)**
10. **(a)**
11. **(a, c, d)**

Hints and Solutions

1. (b)



Or



Ans: 3

2. (b)

Conflict serializability is NOT satisfied by Thomas Write time Stamp Ordering Protocol

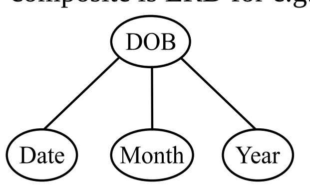
3. (a)

P: Correct TSO protocols are always free from deadlock.

Q: INCORRECT 2PL protocols suffer from deadlock.

4. (c)

P: CORRECT An attribute of an entity can be composite is ERD for e.g.



Q: **CORRECT.** Multi-valued attributes are not allowed.

5. (b)

Since there exists 30% participation at R_2 end there exists extra values in R_2. So, R,M (A B C), R2 (C D) is best design as it allows c to act as a foreign key.

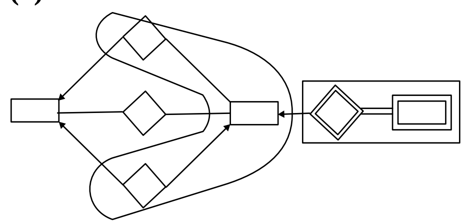
6. (19)

The best possible design.

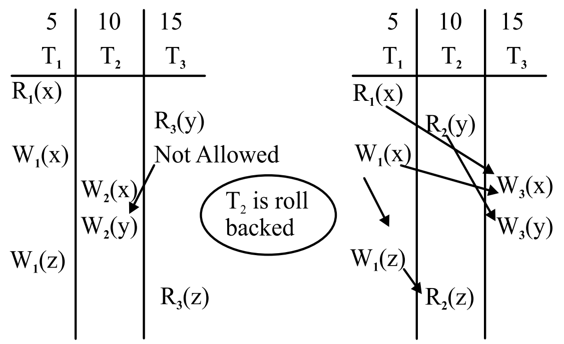
$\therefore X = 9$ and $Y = 5$

$X + 2Y = 9 + 2 \times 5 = 19$

7. (4)



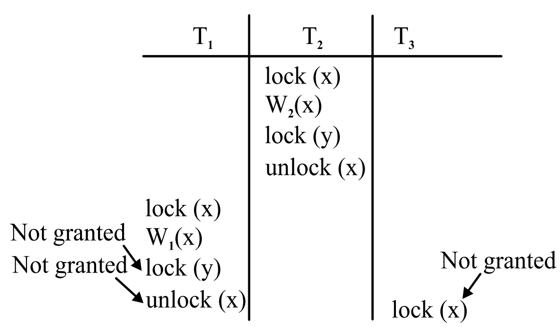
8. (a)



S_2 is allowed by Basic TSO

9. (d)

S_1:



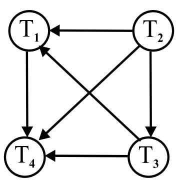
$\therefore$ Schedule S_1 is not allowed by 2PL.

S_2:

T_1	T_2	T_3
lock (x)		
$W_1(x)$		
lock (y)		
unlock (x)		
	lock (x)	Not granted
	$W_2(x)$	Not granted
	lock (y)	
	unlock (x)	
		lock (x)
		$W_3(x)$
		lock (y)
		unlock (x)

$\therefore$ S_2 is also not allowed by 2PL.

10. (a)



$\Rightarrow$conflict serializable

T_1	T_2	T_3	T_4
	lock (x)		
	$R_2(x)$		
	lock (y)		
	lock (z)		
	unlock (x)		
		lock (x)	
		$W_3(x)$	
		unlock (x)	
lock (x)			
$W_1(x)$			
unlock (x)			
	$W_2(y)$		
	unlock (y)		
	$R_2(z)$ unlock (z)		
			lock (x)
			lock (y)
			$R_4(x)$
			$R_3(y)$
			unlock (x)
			unlock (y)

$\therefore$ Allowed by 2PL.

11. (a, c, d)

option (c)**:**

<T1 T2 T3> (10, 30, 20)

10 T_1	20 T_3	30 T_2
r(x)		
		r(y)
		r(x)
w(z)		
r(y)		
	w(y)	
	r(z)	
		w(y)
	w(x)	

Transaction Order:

$\overset{10}{T_1} \rightarrow \overset{20}{T_3} \rightarrow \overset{30}{T_2}$

But Conflict Operation: $r_2(y) \rightarrow w_3(y)$ $(T_2 \rightarrow T_3)$

Som its option (c) not allowed under TSP(Time Stamp Protocol). Similar option (a) & (d) not allowed under TSP.

So, (a), (c), (d) not allowed under Thomas Write Rule.

$r_1(x)\ r_2(y)\ r_2(x)\ w_1(z)\ r_1(y)\ w_3(y)\ r_3(z)\ w_2(y)\ w_3(x)$

option (b):

10 T_1	20 T_2	30 T_3
r(x)		
	r(y)	
	r(x)	
w(z)		
r(y)		
		w(y)
		r(z)
	w(y)	
		w(x)

$\overset{10}{T_1} \rightarrow \overset{20}{T_3} \rightarrow \overset{30}{T_2}$

Order <T_1 T_2 T_3>

& Conflict Operation order also <T_1 T_2 T_3>

Hence, option (a, c, d) are correct.

For more questions, kindly visit the library section: Link for web: https://smart.link/sdfez8ejd80if

PW Mobile APP: https://smart.link/7wwosivoicgd4

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 06

Database Management System

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. Consider a relation R(<u>P</u>, Q) and Q is a foreign key referring, key attribute P of the same relation R, with x distinct tuples. Assume that R is non-empty. What is the maximum and minimum number of tuples that can be generated as the output of the relational algebra query $\pi_{P, Q}(R) \bowtie \pi_{Q, P}(R)$ respectively?

(a) x and x^2 (b) x and x
(c) 0 and x^2 (d) 0 and x

[NAT]

2. Assume the following relations R_1 (P,Q,R,S,T) R_2 (R,S,T,U,V), R_3 (T,U,V,W) and R_4 (A,B,C,D). Then number of attributes in the output of the relational table of relational algebra query $(R_1 \bowtie R_2) \times (R_3 \bowtie R_4)$ is ?

[MSQ]

3. Consider two relations R(P, Q) and S(P,Q) have exactly the same schema. Which of the following equalities in relational algebra holds in relational algebra?

(a) $R \cap S = R - (R - S)$
(b) $R \cap S = S - (S - R)$
(c) $R \cap S \subseteq R \bowtie S$
(d) $R \cap S = R \times S$

[MSQ]

4. Which of the following statement is/are True?

(a) For a given relation A(P, Q) and B (P, R) , the natural join $A \bowtie B$ is equal to $A \cap B$.
(b) It is possible to define the relational algebra operator intersection ($\cap$) using the join operator $\bowtie$.
(c) Given relation A(P, Q, R) and B (S, T), the natural join $A \bowtie B$ is equal to $A \times B$.
(d) It is possible to express the relational algebra operator intersection ($\cap$) using the difference operators (–).

[MCQ]

5. Consider the following 3 relations schemas.

Show(<u>ShowID</u>, Title, Year, Studio, Language, Genre, PartOfStart, Length)

Actor(<u>ActorsID</u>, Name, Age, Gender)

Perform(<u>ShowID, ActorsID</u>) and the following two relational algebra expressions.

1. $\Pi_{title,\ year,\ name}$ ($\sigma_{year\ \geq\ 2001}$ (Show) $\bowtie$ Perform $\bowtie$ Actor)
2. $\Pi_{title,\ year,\ name}$ ($\sigma_{year\ \geq\ 2001}$ (show $\bowtie$ perform $\bowtie$ Actor))

Which of the following statement is/are true?

(a) Both queries returns identical row sets for any database instance.
(b) There exists some DB instances for which 1 and 2 reforms different row sets.
(c) There exist database instances for which 1 returns strictly fewer rows than 2.
(d) There exists dB instance for which 2 returns strictly fewer rows than 1

Q.6 to 10 Carry TWO Marks Each

[NAT]

6. Consider the following two relations A and B.

A		B	
P	Q	R	S
1	1	4	2
2	1	3	4
3	3	3	5
3	4	1	3

and the following relational algebra query.

$\pi_{P,S}(A \times B) - \rho_{Q\rightarrow P}(\pi_{Q,S}(A \bowtie_{Q=R} B)))$

The number of tuple returned by the above query is__.

[MSQ]

7. Given two relations A and B with exactly the same schema, where A contains x tuples, B contains y tuples, and $y > x > 0$. Which of the following statement is/are true?

(a) The maximum number of tuples in the resulting relations produced by relational algebra expression $A \cup B$ is y.

(b) The maximum number of tuples in resulting relations produced by relational algebra expression $A - B$ is y.

(c) The maximum number of tuples in the resulting relations produced by relational algebra expression $A \bowtie B$ is $x + y$.

(d) The maximum number of tuples in the resulting relation produced by relational algebra expression $A \times B$ is $x \times y$.

[MCQ]

8. A foreign key is a set of attributes in a table that refers to the ________of another table.

(a) Primary key (b) Foreign key

(c) Composite key (d) None of the above

[MSQ]

9. Select the true statement regarding foreign key.

(a) Child records may have duplicates and nulls.

(b) parent records can be deleted if no child exists.

(c) Foreign key must refer composite key in primary table.

(d) Foreign key column and constraint column should have matching data types.

[MCQ]

10. Consider the statements.

S_1: The table with foreign key is called the child table and the table with the primary key is called the referenced or parent table.

S_2: The foreign key constraint prevents invalid data from being inserted into the foreign key column.

Which among the statements are true?

(a) Only S_1

(b) Only S_2

(c) Both S_1 and S_2 are true

(d) Neither S_1 nor S_2 is true.

Answer Key

1.	**(d)**	**6.**	**(9)**
2.	**(15)**	**7.**	**(d)**
3.	**(a, b)**	**8.**	**(a)**
4.	**(b, c, d)**	**9.**	**(a, b, d)**
5.	**(a)**	**10.**	**(c)**

Hints and Solutions

1. (d)

Consider the following instance of table R.

π (R)		π (R)	
P	Q	Q	P
1	Null	Null	1
2	Null	Null	2
3	Null	Null	3
4	Null	Null	4
5	Null	Null	5
6	Null	Null	6
7	Null	Null	7

The tuples that can be generated as the output of the relational algebra query is 0.

Now consider the following instance of table

π (R)		π (R)	
P	Q	Q	P
1	1	1	1
2	1	1	2
3	1	1	3

The tuples that can be generated as the output of relational algebra query is 3.

2. (15)

Natural join combine the common attributes while generating the output relation table:

So, number of column in ($R_1 \bowtie R_2$) = PQRSTUV and in ($R_3 \bowtie R_4$) = TUVWABCD.

But in the **Cross Product** or **Cartesian product** (R x S), it generate the number of attributes as "number of attributes in R + number of attributes in S".

Hence, the total number of column in the cartesian product will be 15 i.e.

P Q R S T U V T U V W A B C D.

3. (a, b)

Consdier the following instence of table.

R		S	
P	Q	P	Q
1	2	1	2
1	3	2	3
2	4	2	4
		3	5

Option (a) true

$R \cap S = R - (R - S)$

R∩S		R–S		R–(R–S)	
P	Q	P	Q	P	Q
1	2	1	3	1	2
2	4			2	4

Option (b) true

$R \cap S = S - (S - R)$

R ∩ S		S – R		S – (S – R)	
P	Q	P	Q	P	Q
1	2	2	3	1	2
2	4	3	5	2	4

Option (c) when both relation contains not null rows then $R \cap S = R \bowtie S$, but when table has row which is null then $R \bowtie S \subseteq R \cap S$. So, this is false.

R ∩ S		R ⋈ S	
P	Q	P	Q
1	2	1	2
2	4	2	4

NOTE: Intersection operation work on relation with Union compatible, where as Natural Join work on equality of common attributes.

Option (d) false

The resulting table of "INTERSECTION" operation will have 2 attributes that P and Q whereas the "CROSS PRODUCT" will have 4 attribites that is R.P R.Q S.P S.Q with 16 tuples in resulting table. Hence, resulting table would not be same always.

4. (b, c, d)

Option a: False

A		B		A⋈B			A∩B		
1	2	1	3	P	Q	S	P	Q	R
2	3			1	2	3			
4	5								

Option b is true as A ∩ B = A⋈B when no null values are there.

Option c is true because if there is no common colmun so the result of natural join and cartesian product is same.

Option d is true as A∩B = B – (B – A).

5. (a)

Both the query is eqivalent as we know that natural join (⋈) is associatve so the result will be same for (show) ⋈ (performs ⋈ Actor) and show ⋈ (performs ⋈ Actor).

6. (9)

π_{PS} (A×B)		–	π_{QS} (A ⋈ B)	
1	2		P	S
1	4		1	3
1	5		3	4
1	3		4	2
2	2		3	5
2	5			
2	3			
2	2			
3	2			
3	4			
3	5			
3	3			

The number of rows returned by query is 9.

7. (d)

(a) False, The maximum number of tuples in the resulting relations produced by relational algebra expression A∪ B is $x + y$.

(b) Flase, the maximum number of tuples in the result produced by relational algebra expression A – B is x.

(c) False, The maximum numbe of tuple in the resulting relation produced by relational algebra rexpression A ⋈B is maximum (x, y).

(d) True, The maximum number of tuple in the resulting relation produced by relational algebra expression A ×B is $x \times y$.

8. (a)

A foreign key is a set of attributes in a table that refers to the primary key of another table.

9. (a, b, d)

(True a) Child may have duplicate and nulls.

(True b) Parent records can be deleled if no child exists.

(False c) Foreign key must refer primary key in primary table but not composite key.

(True d:) Foreign key columns and constraint column should have matching data types.

10. (c)

S_1 (True): The table with foreign key is called child table, and the table with the primary key is called the referenced or parent table.

S_2(True): The foreign key constraint prevents invalid data form being inserted into the foreign key column, because it has to be one of the values contained in the parent table.

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 07

Subject : Database Management System

Topic : Query Language

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. Consider the following statements-

I: Let R_1 be a relation having attribute set (A, B, C) and R_2 be a relation having attribute set (P, Q, R), then the attribute set of $R_1 \cup R_2$ is (P, Q, R).

II: There always exists unique tuples in $R_1 \cup R_2$.

Which of the given statements is/are correct?

(a) Both I and II
(b) Neither I nor II
(c) I only
(d) II only

[MSQ]

2. Consider the following relation:

Student (<u>Sid</u>, Gender, Subject, Marks)

SQL Query:

```
SELECT A.Subject FROM Student A
WHERE A.Gender = Male
GROUP BY Subject
HAVING Avg(Marks)> (SELECT Avg(Marks)
                    FROM Student B
                    WHERE B.gender = female
                    and B. Subject = A. Subject)
```

The above SQL query retrieves-

(a) Subject where the average marks of the male students is more than that of the female students.
(b) Subject where the average marks of the female students is more than that of the male students.
(c) Subject where a male student scored more than all the female students.
(d) None of the above.

[MCQ]

3. Consider the following relation-

Student (<u>Sid</u> Marks)

SQL query:

```
SELECT A.Sid FROM student A
WHERE (SELECT COUNT (DISTINCT B.Marks)
       FROM Students B
       WHERE A. marks < B.marks) < 2
```

The above SQL query results into-

(a) Sids of students who scored less than any two students
(b) Sids of the students who scored the top 2 highest marks
(c) Sids of the students who scored the bottom 2 least marks
(d) Sids of the students who scored the 2nd highest marks

[NAT]

4. Consider the relations:

Supply (<u>SupplierID, Itemcode</u>) with 1000 tuples

Inventory (<u>Itemcode</u>, color) with 2500 tuples

Let p and q be the number of maximum and minimum records in Supply JOIN Inventory, the value of p + q is __________. (Itemcode is FK in Supply table)

[MCQ]

5. Consider the following relations:

Supply (<u>SupplierID, ItemCode</u>)

Inventory (<u>Itemcode</u>, Color)

SQL Query:

```
Select distinct A. SupplierID from Supply as A where
NOT UNIQUE (Select B. SupplierID
from Inventory, Supply as B
```

Where A. SupplierID = B. SupplierID

and A. Itemcode = Inventory. Itemcode

and Inventory. Color = “Green”);

The above SQL query finds all suppliers who-

(a) Do not supply any green item.

(b) Supply exactly one green item.

(c) Supply at least one green item.

(d) Supply at least two green items.

Q.6 to 10 Carry TWO Mark Each

[NAT]

6. Consider a Database of the Dealer of Product-info as following.

Product -info

Dealer-no	Part-no	Color Code
A_{66}	P_2	C_{11}
A_{22}	P_1	C_{21}
A_{77}	P_4	C_{31}
A_{55}	P_3	C_{41}
A_{22}	P_3	C_{51}
A_{77}	P_2	C_{61}
A_{99}	P_1	C_{71}

Consider the following query:

Select A·Color Code, A· Dealer-no

FROM Product-info A, Product -info as B

WHERE A·Dealer-no = B· Dealer-no and A·Part no < > B· Part-no;

The number of tuples in the output of above will be________.

[MSQ]

7. Consider the following relations-

Supply (<u>SupplierID, Itemcode</u>)

Inventory (<u>Itemcode</u>, color)

S_1: Those supplier IDs are to be found who supply SOME items of red or green color.

Which of the following relational algebra expression(s) is/are equivalent to statement S_1?

(a) $\pi_{\text{SupplierID}}\left(\text{Supply} \bowtie \sigma_{\substack{\text{color = Red}\\ \vee \\ \text{color = green}}}(\text{Inventory})\right)$

(b) $\pi_{\text{SupplierID}}\left(\sigma_{\substack{\text{color = Red}\\ \wedge \\ \text{color = green}}}(\text{Supply} \bowtie \text{Inventory})\right)$

(c) $\pi_{\text{SupplierID}}(\text{Supply} \bowtie \sigma_{\text{color = green}}(\text{Inventory}))$

$\cup\ \pi_{\text{SupplierID}}(\text{Supply} \bowtie \sigma_{\text{color = red}}(\text{Inventory}))$

(d) $\pi_{\text{SupplierID}}\left(\text{Supply} \bowtie_{\substack{\text{color = red}\\ \wedge \\ \text{color green}}} \text{Inventory}\right)$

[MCQ]

8. Consider the following relations:

Supply (<u>SupplierID, Itemcode</u>)

Inventory (<u>Itemcode</u>, Color)

Retrieve the suppliers who supply every item of colors red and green.

S_1: $$\frac{\Pi_{\text{SupplierID,Itemcode}}(\text{Supply})}{\Pi_{\text{Itemcode}}\left(\sigma_{\substack{\text{Color = red}\\ \vee \\ \text{Color = green}}}(\text{Inventory})\right)}$$

S_2:

$$\frac{\Pi_{\text{SupplierID Itemcode}}(\text{Supply})}{\Pi_{\text{Itemcode}}\left(\sigma_{\text{Color = red}}(\text{Inventory})\right)} \cap \frac{\Pi_{\text{SupplierID Itemcode}}(\text{Supply})}{\Pi_{\text{Itmecode}}\left(\sigma_{\text{Color = green}}(\text{Inventory})\right)}$$

Which of the given statements is/are CORRECT?

(a) S_1 only

(b) S_2 only

(c) Both S_1 and S_2

(d) Neither S_2 nor S_2

[MCQ]

9. Consider the following relations-

Supply (<u>SupplierID, Itemcode</u>)

Relational Algebra Expression-

P:

$$\sigma_{\substack{\text{A.SupplierID = B.SupplierID}\\ \text{and}\\ \text{B.SupplierID = C.SupplierID}\\ \text{and}\\ \text{A.Itemcode} \neq \text{B.Itemcode}\\ \text{and}\\ \text{C.Itemcode} \neq \text{A.Itemcode}}}\left(\rho(\text{A,Supply}) \times \rho(\text{B,Supply})\ \rho(\text{C,Supply})\right)$$

$\Pi_{\text{SupplierID}}(\text{Supply}) - \Pi_{\text{SupplierID}}(\text{P})$ retrieves-

(a) Suppliers who supply at least two items
(b) Suppliers who supply at most two items
(c) Suppliers who supply at least three items
(d) Suppliers who supply at most three items

[MCQ]

10. Consider the following relation and query Sailors (Sid, Sname, rating, age)

SELECT S. Sname
FROM Sailors S
WHERE S.age >
(SELECT Max(S_2. age)
FROM Sailors S_2
WHERE S_2. rating = 10**)**

The above Query returns:

(a) Name of sailors who are older than the oldest sailor with a rating of 10.
(b) Name of sailors who are younger than the oldest sailor with a rating of 10.
(c) Name of sailors who are older than the youngest sailor with a rating of 10.
(d) Name of sailor who are younger than the youngest sailor with a rating of 10.

Answer Key

1. (d)
2. (a)
3. (b)
4. (2000)
5. (d)
6. (4)
7. (a, c)
8. (c)
9. (b)
10. (a)

Hints and Solutions

1. (d)

I: INCORRECT, $R_1 \cup R_2$ is the schema of R_1 (A, B, C) itself. The attribute set of $R_1 \cup R_2$ is (A, B, C).

II: CORRECT, $R_1 \cup R_2$ always contain unique tuples.

2. (a)

The above SQL query is a correlated query that finds the subject in which the average marks of the male student is more than the average marks of the female students.

A			
(Sid	**Gender**	**Subject**	**Marks)**
1	F	P	10
2	M	P	20
3	F	P	30
4	M	P	30

B			
(Sid	**Gender**	**Subject**	**Marks)**
1	F	P	10
2	M	P	20
3	F	P	30
4	M	P	30

Average (marks) of male stduents in (A) = 25

Average (marks) of female student in (B) = 20

$25 > 20 \rightarrow$ P is selected.

3. (b)

Consider

A		B	
Student		**Student**	
(Sid	**Marks)**	**(Sid**	**Marks)**
1	10	1	10
2	40	2	40
3	30	3	30
4	40	4	40

A. Marks < B. marks

$10 < \begin{bmatrix} 40 \\ 30 \\ 10 \end{bmatrix} \Rightarrow$ select count (Distinct B. marks)

$\Downarrow$

$2 < 2 \rightarrow$ False

$\boxed{1 \quad 10}$ Not Selected

A. Marks < B. marks

$40 < [\ ] \rightarrow$ select count (Distinct B. marks)

$\Downarrow$

$0 < 2 \rightarrow$ true

$\boxed{2 \quad 40}$ Selected

A. Marks < B. marks

$30 < \begin{bmatrix} 40 \\ 40 \end{bmatrix} \rightarrow$ select count (Distinct B. marks)

$\Downarrow$

$1 < 2 \rightarrow$ true

$3 \ \boxed{30} \rightarrow$ Selected

A. Marks < B. marks

$40 < [\ ] \Rightarrow$ select count (Distinct B. marks)

$\Downarrow$

$0 < 2 \rightarrow$ true

$\boxed{4 \quad 40} \rightarrow$ Selected

Hence, students who score top two highest marks are selected.

4. (2000)

Since a foreign key dependency exists between Supply and Invertory.

Minimum number of tuples in Supply $\bowtie$ Inventory = 1000

Maximum number of tuples in Supply $\bowtie$ Inventory = 1000

$\therefore$ p + q = 1000 + 1000 = 2000

5. (d)

Not unique returns TRUE for repeated values

Inner Query will give SupplierID who supplies at least one green item. If the suppliers supply more than one green item, then only NOT UNIQUE condition is true, and that (SupplierID) is selected.

$\therefore$ The above SQL query supply at least two green items.

6. (4)

Product-info A

Dealer-no.	**Part-no.**	**Color Code**
A_{66}	P_2	C_{11}
A_{22}	P_1	C_{21}
A_{77}	P_4	C_{31}
A_{55}	P_3	C_{41}
A_{22}	P_3	C_{51}
A_{77}	P_2	C_{61}
A_{99}	P_1	C_{71}

Product-info B

Dealer-no.	**Part-no.**	**Color Code**
A_{66}	P_2	C_{11}
A_{22}	P_1	C_{21}
A_{77}	P_4	C_{31}
A_{55}	P_3	C_{41}
A_{22}	P_3	C_{51}
A_{77}	P_2	C_{61}
A_{99}	P_1	C_{71}

Output:-

Dealer-no	**Color Code**
A_{22}	C_{21}
A_{77}	C_{31}
A_{22}	C_{51}
A_{77}	C_{61}

7. (a, c)

SOME is equivalent to ⋈.

(a) $\pi_{\text{SupplierID}}\left(\text{Supply} \bowtie \sigma_{\substack{\text{color = Red} \\ \vee \\ \text{color = green}}}(\text{Inventory})\right)$

(c) $\pi_{\text{SupplierID}}\left(\text{Supply} \bowtie \sigma_{\text{color = red}}(\text{Inventory})\right)$

$\cup\, \pi_{\text{SupplierID}}\left(\text{Supply} \bowtie \sigma_{\text{color = green}}(\text{Inventory})\right)$

8. (c)

To retrieve suppliers who supply every red and green item-

$$= \Pi_{\text{SupplierID}}(\text{Supply}) - \Pi_{\text{SupplierID}}\left(\Pi_{\text{SupplierID}}^{(\text{Supply})}\right.$$

$$\left. \times \Pi_{\text{Itemcode}}\left(\sigma_{\substack{\text{Color = red} \\ \vee \\ \text{Color = green}}}(\text{Inventory})\right) - \Pi_{\text{SupplierID, Itemcode}}(\text{Supply})\right)$$

$$= \frac{\Pi_{\text{SupplierID,Itemcode}}(\text{Supply})}{\Pi_{\text{Itemcode}}\left(\sigma_{\substack{\text{Color = red} \\ \vee \\ \text{Color = green}}}(\text{Inventory})\right)}$$

9. (b)

$\Pi_{\text{SupplierID}}(P)$ is a relational algebra expression that finds the supplier who sells at least 3 items.

$\Pi_{\text{SupplierID}}(\text{Supply}) - \Pi_{\text{SupplierID}}(P)$

$\Downarrow$

finds the supplier who sells atmost two items.

10. (a)

Name of sailors who are older than the oldest sailor with a rating of 10.

Branch : CS/IT **Batch:Hinglish**

WEEKLY TEST – 01

Digital Logic

Logic Gates

Maximum Marks 20

Q.1 to 6 Carry ONE Mark Each

[MCQ]

1. The number of boolean functions that can be generated by n variables is equal to

(a) $2^{2^{n-1}}$ (b) 2^{2^n}

(c) 2^{n-1} (d) 2^n

[MCQ]

2. The logical expression $y = A + \overline{A}B$ is equivalent to

(a) $y = AB$

(b) $y = \overline{A}B$

(c) $y = \overline{A} + B$

(d) $y = A + B$

[MCQ]

3. The Boolean expression

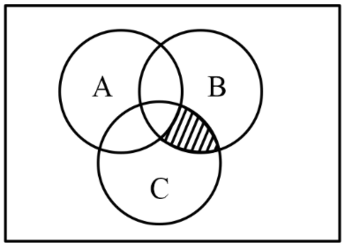
$(X + Y)(X + \bar{Y}) + \overline{(\bar{X}\bar{Y}) + \bar{X}}$ simplifies to

(a) X (b) Y

(c) XY (d) X+Y

[MCQ]

4. The shaded portion in the Venn diagram shown in the figure represents the Boolean function

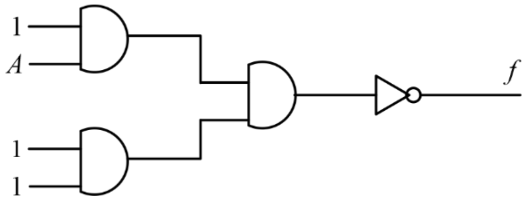


(a) $\bar{A}BC$ (b) $AB\bar{C}$

(c) ABC (d) $A\bar{B}C$

[MCQ]

5. For the given logic circuit the expression implemented at the output f is



(a) 1 (b) 0

(c) A (d) $\overline{A}$

[MCQ]

6. The complete set of only those Logic Gates designated as Universal Gates is

(a) NOT, OR and AND Gates

(b) XNOR, NOR and NAND Gates

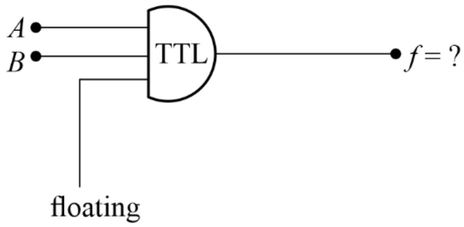
(c) NOR and NAND Gates

(d) XOR, NOR and NAND Gates

Q.7 to 13 Carry TWO Mark Each

[MCQ]

7.



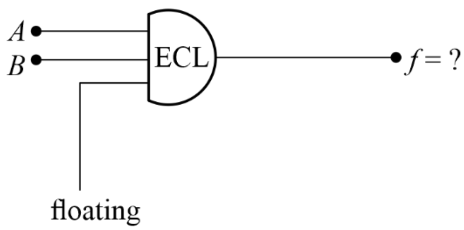
Find expression of f?

(a) AB (b) 1

(c) $A + B$ (d) $\overline{AB}$

[MCQ]

8.



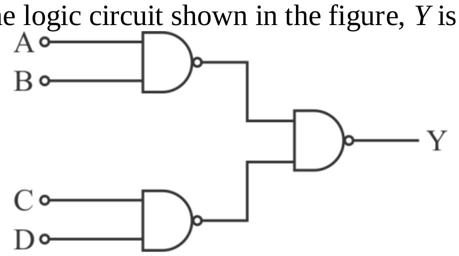
Find expression of f?

(a) 0 (b) 1

(c) AB (d) $\overline{AB}$

[MCQ]

9. In the logic circuit shown in the figure, Y is given by



(a) $Y = ABCD$

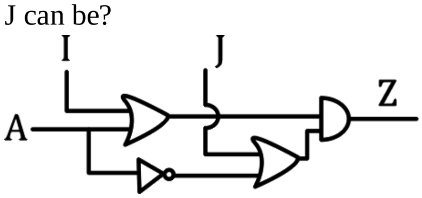
(b) $Y = (A + B)(C + D)$

(c) $Y = A + B + C + D$

(d) $Y = AB + CD$

[MCQ]

10. A simple logic circuit is shown below, if the output Z is given as $Z = \overline{A} + B$. The possible value of I, and J can be?

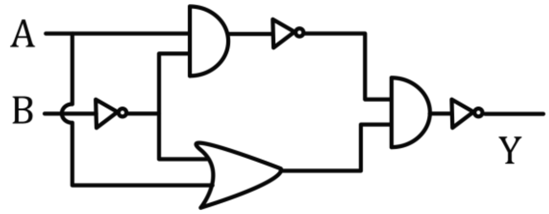


(a) I=B, J=1 (b) I=1, J=1

(c) I=1, J=B (d) I=A, J=1

[MCQ]

11. Determine the logical expression of Y for the given logic circuit.

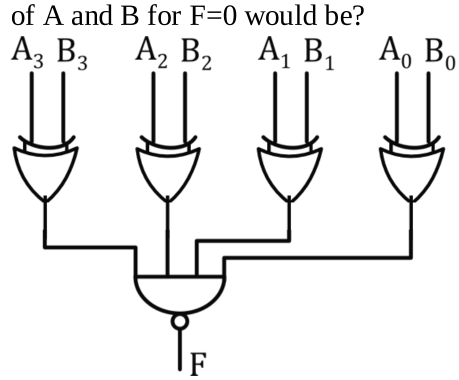


(a) NAND (b) XOR

(c) XNOR (d) NOR

[MCQ]

12. If A and B are inputs and F is the output. The value of A and B for F=0 would be?

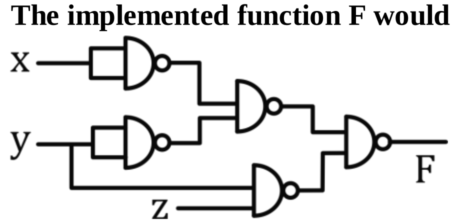


(a) 1010, 1010 (b) 0101, 0101

(c) 0010, 1101 (d) 0010, 1011

[MCQ]

13. The implemented function F would be



(a) $\bar{X}\bar{Y} + YZ$ (b) $Y + \bar{X}\bar{Y}Z$

(c) $XY + \bar{Y}\bar{Z}$ (d) $X\bar{Y} + \bar{Y}\bar{Z}$

Answer Key

1. (b)
2. (d)
3. (a)
4. (a)
5. (d)
6. (c)
7. (a)
8. (a)
9. (d)
10. (c)
11. (b)
12. (c)
13. (a)

CS & IT **Batch : Hinglish**

Weekly Test - 02
Digital Logic
Minimization

Time Duration - 50 Min **Maximum Marks –** 20

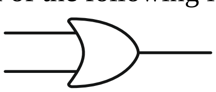
Note : Negative Marking - 1/3, NAT no negative marking
{For MSQs no part marking no negative marking(from week onwards)}

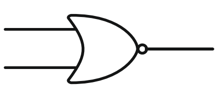
Part A : 1 to 6 questions each will carry 1 marks (MCQs + NAT)

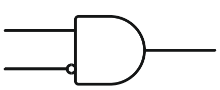
1. The Boolean function,
$f = PQ\overline{R} + \overline{P}QR + PQR + \overline{P}Q\overline{R}$
Minimal product is,
(a) $P\overline{Q}$ (b) $P + Q\overline{R}$
(c) Q (d) None of the above

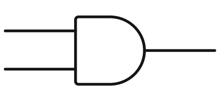
2. The min term/ max term form of the given Boolean expression,
$f(A, B, C) = \left(AB + B\overline{C} + \overline{A}C\right)(A + C)$
is represented by,
(a) $\sum m(1, 2, 6, 7)$ (b) $\prod M(0, 2, 4, 5)$
(c) $\sum m(1, 2, 3, 6)$ (d) $\prod M(0, 3, 4, 5)$

3. Which of the following is/are universal gate?

(i) 

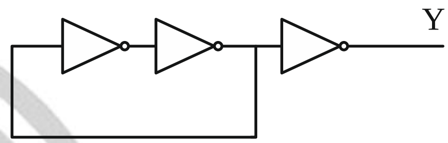
(ii) 

(iii) 

(iv) 

(a) Only (ii) (b) (ii) and (iv)
(c) (ii) and (iii) (d) (ii), (iii) and (iv)

4. All the inverters have propagation delay (t_d) 0.5μsec, as shown below,



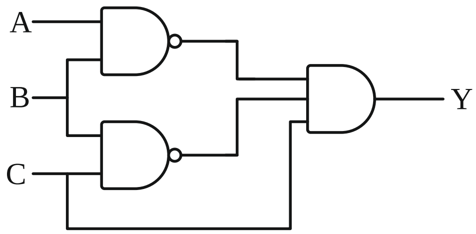
At output (Y) we will get?
(a) Square waveform of $f = \frac{1}{3}$ MHz
(b) Square waveform of $f = \frac{1}{2}$ MHz
(c) Square waveform of $f = 1$ MHz
(d) None of the above

5. A Boolean function F can be represented as
$F(A, B, C) = \overline{\overline{A} + \left[\overline{B + \overline{C}\left(\overline{\overline{AB + A\overline{C}}}\right)}\right]}$
Then the minimum number of 2 input NOR gates can be required to implement the above function is equal to_______?

6. A Boolean function of two variables X and Y is defined as follows:
F (0, 0) = 1 = F (1, 1) and F (0, 1) = F (1, 0) = 0
Assuming complement of X and Y are not available a minimum cost solution for realizing F using 2-input NAND gates (each having unit cost) would have total cost of _______ unit.

Part B: 7 to 13 questions each will carry 2 marks (MCQs + NAT)

7. Which of the following is not correct?



(a) Y is dependent of B
(b) Y is independent of A
(c) Y is dependent of B and C
(d) Y is independent of C

8. We have two binary numbers A and B of 4-bit each, then the number of times, comparator output will be 1 that generates output 1 if A < B _______.

9. A K-map is given below-

Y	$\bar{A}$	A
$\bar{B}$	X	1
B	0	C

X-don't care

The minimized solution of above K-map will be

(a) $A\bar{B}+AC$ (b) $\bar{B}\bar{C}+A\cdot C$
(c) $AB+AC$ (d) $\bar{B}\cdot\bar{A}+A\cdot C$

10.

Y	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1	1	X	
$\bar{A}B$		1	X	
AB		1	1	
$A\bar{B}$			1	

X-don't care

Minimized solution of above K-map will be

(a) $BD+CD+\bar{A}D+\bar{A}\bar{B}\bar{C}$
(b) $BD+CD+\bar{A}\bar{B}\bar{C}$
(c) $BD+\bar{A}\bar{B}+\bar{C}\bar{D}$
(d) $BD+CD+\bar{A}\bar{C}D+\bar{A}\bar{B}\bar{C}$

11. Which of the following K-map represents the borrow output of full subtractor (A-B) with C as borrow given to previous bit

(a)

	$\bar{C}$	C
$\bar{B}$		$\bar{A}$
B	$\bar{A}$	1

(b)

	$\bar{C}$	C
$\bar{B}$		$\bar{A}$
B	(A+C)	1

(c)

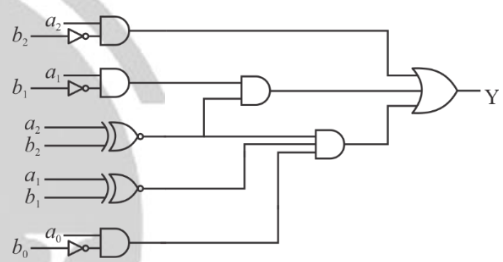
	$\bar{C}$	C
$\bar{B}$		A
B	$\bar{A}+\bar{C}$	1

(d)

	$\bar{C}$	C
$\bar{B}$		$\bar{A}$
B	1	A

12. A comparator circuit is designed to compare two modes A and B.

$A=a_2\,a_1\,a_0 \qquad B=b_2\,b_1\,b_0$



Then which of the following is true ?
(a) This circuit compares A and B and output Y is '1' when A = B.
(b) This circuit compares A and B and output Y is '1' when A > B.
(c) This circuit compares A and B and output Y is '1' when B > A.
(d) This circuit gives the final carry output of (A+B) addition.

13. Function $f=\bar{A}BD+\bar{A}CD+\bar{A}C\bar{D}+AB\bar{C}D+ABCD$ minimum number of NAND gates required to implement the function?

Answer Key

1. (c)
2. (b)
3. (c)
4. (d)
5. (3 to 3)
6. (5 to 5)
7. (d)
8. (120 to 120)
9. (b)
10. (b)
11. (a)
12. (b)
13. (4)

CS & IT **Batch : Hinglish**

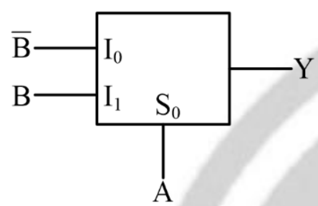
Weekly Test - 03
Digital Logic
Combinational Circuit

Time Duration - 50 Min **Maximum Marks –** 20

Note : Negative Marking - 1/3, NAT no negative marking
{For MSQs no part marking no negative marking(from week onwards)}

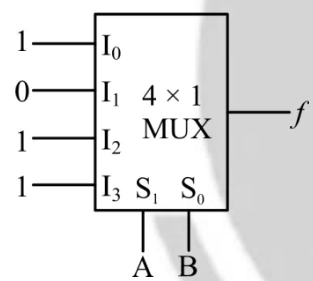
Part A : 1 to 6 questions each will carry 1 marks (MCQs + NAT)

1. The logic gate of given multiplexer circuit is



(a) AND (b) X-OR
(c) XNOR (d) NAND

2. The logic function implemented by 4 × 1 mux, is



(a) A + B (b) $A + \bar{B}$
(c) $\bar{A} + B$ (d) $\bar{A} + \bar{B}$

3. How many AND gates are required for a 1 × 8 Demux ?

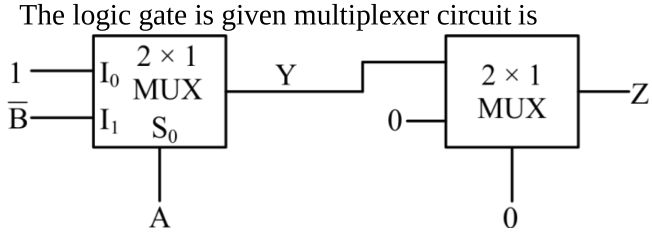
4. A multiplexer with a 4-bit data select input is a
(a) 4 × 1 mux (b) 16 × 1 mux
(c) 8 × 1 mux (d) 2 × 1 mux

5. A designer has multiplexer units of size 2 × 1 and multiplexer of size 16 × 1 is to be realized. The number of units of 2 × 1 mux is required will be ________.

6. How many OR gates are required for an octal to binary encoder?
(a) 3 (b) 2
(c) 8 (d) 10

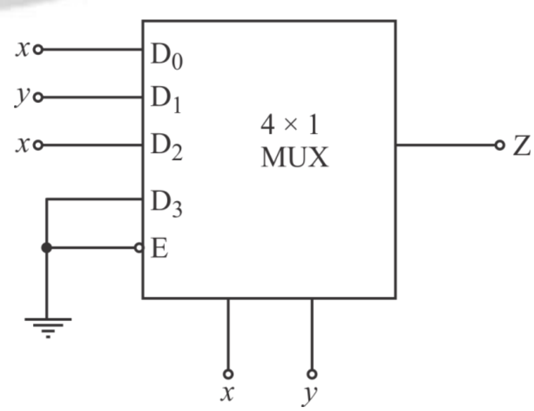
Part A : 7 to 13 questions each will carry 2 marks (MCQs + NAT)

7. The logic gate is given multiplexer circuit is



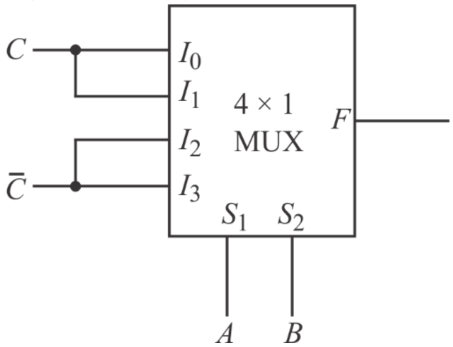
(a) AND (b) XOR
(c) NAND (d) NOR

8. The logic function implemented by 4 × 1 MUX, is



(a) $Z = xy$ (b) $Z = x + y$
(c) $Z = \overline{x + y}$ (d) $x \oplus y$

9. The logic realized by the circuit shown in figure is



(a) $F = A \odot C$ (b) $F = A \oplus C$

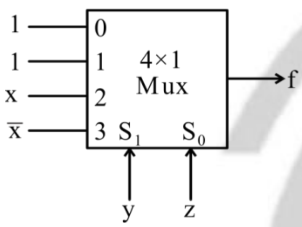
(c) $F = B \odot C$ (d) $F = B \oplus C$

10. Which one of the following circuits implements the Boolean function given below?

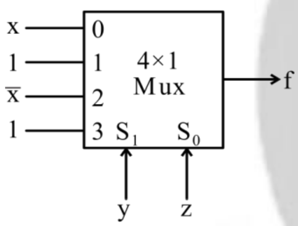
$$f(x, y, z) = m_0 + m_1 + m_3 + m_4 + m_5 + m_6$$

where m_i is the i^{th} minterm.

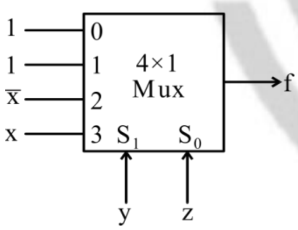
(a)



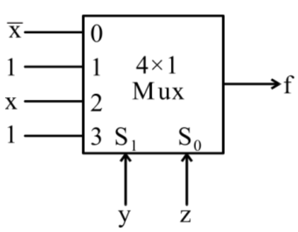
(b)



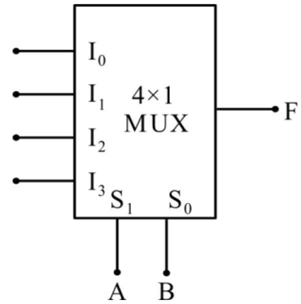
(c)



(d)



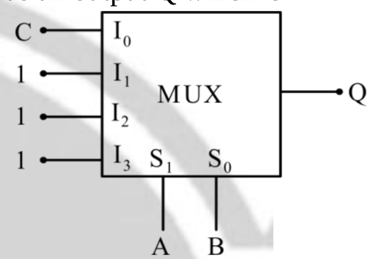
11. In the 4 × 1 multiplexer, the output F is given by $F = A \oplus B$. Find the required input $I_3I_2I_1I_0$.



(a) 1010 (b) 0110

(c) 1000 (d) 1110

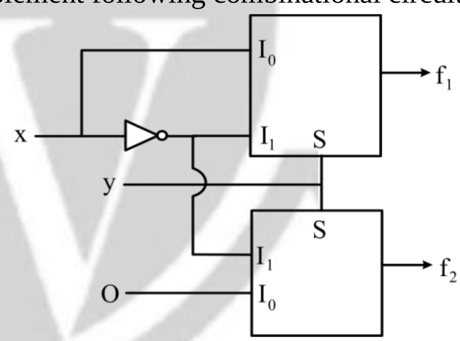
12. The combinational logic circuit shown in the given figure has an output Q which is



(a) ABC (b) A + B + C

(c) $A \oplus B \oplus C$ (d) A . B + C

13. Minimum number of NAND gates required to implement following combinational circuit are_____.



Answer Key

1. (c)
2. (b)
3. (8)
4. (b)
5. (15)
6. (a)
7. (c)
8. (d)
9. (b)
10. (a)
11. (b)
12. (b)
13. (5)

Hints and solutions

1. **(c)**

$Y = \bar{S}_0 I_0 + S_0 I_1$

$Y = \bar{A}\bar{B} + AB$

$Y = A \odot B$

2. **(b)**

$f = 1.\bar{A}\bar{B} + 0.\bar{A}B + 1.A\bar{B} + AB.1$

$f = \bar{A}\bar{B} + A\bar{B} + AB$

$f = \bar{B} + AB = (\bar{B} + B)(\bar{B} + A)$

$f = A + \bar{B}$

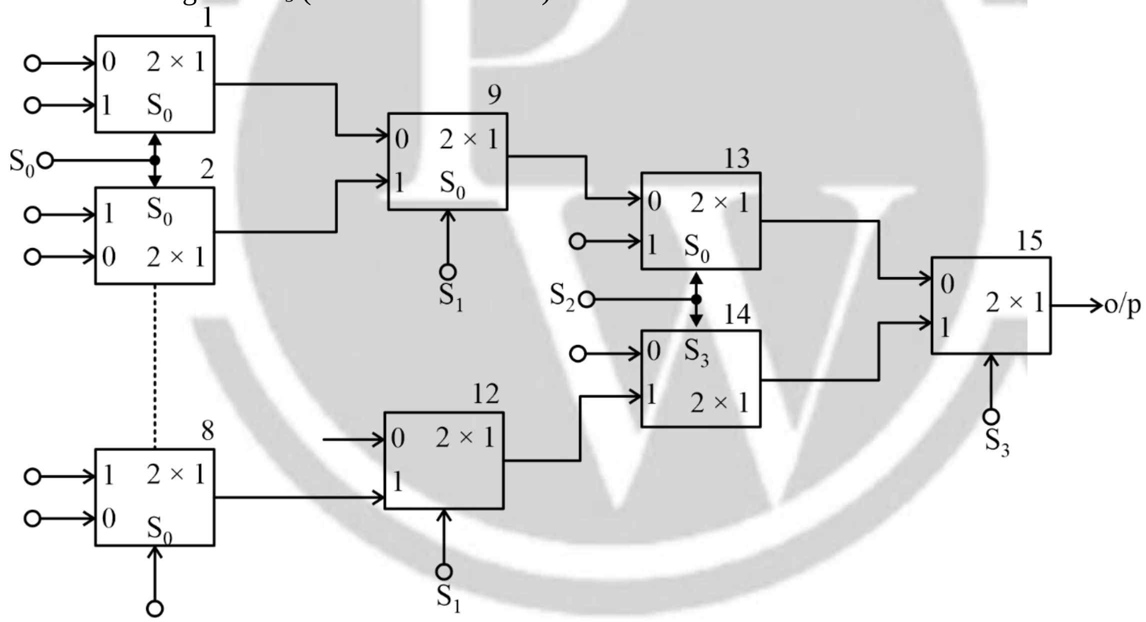
3. **(8)**

Number of AND gates = Number of output in DEMUX

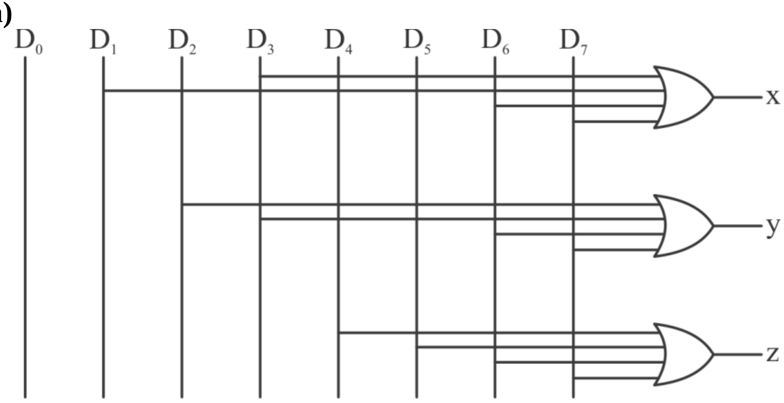
4. **(b)**

16 × 1 mux is implemented with 4-bit data select input.

5. Number of units of 2 × 1 MUXs required = 8 + 4 + 2 + 1 = 15 as demonstrated below. Select lines are assigned in reverse order starting from S_3 (MSB of select lines)



6. **(a)**



7. (c)

$Y = \bar{A} + \bar{A}B = \bar{A} + B$

$Z = \bar{O}.Y + O.O$

$Z = Y = \bar{A} + \bar{B}$

$Z = \overline{AB}$

NAND Gate

8. (d)

$z = \bar{x}\,y\,x + \bar{x}\,y\,y + x\bar{y}\,x + x\,y \cdot 0$

$z = \bar{x}\,y + x\bar{y}\,x$

$z = \bar{x}\,y + x\bar{y}$

$z = x \oplus y$

9. (b)

$F = \bar{A}\bar{B}C + \bar{A}BC + A\bar{B}\bar{C} + AB\bar{C}$

$F = \bar{A}C(B + \bar{B}) + A\bar{C}(B + \bar{B})$

$F = \bar{A}C + A\bar{C}$

$F = A \oplus C$

10. (a)

$f = \bar{y}\,\bar{z} \cdot 1 + \bar{y}\,z \cdot 1 + y\,\bar{z} \cdot x + y\,z\,\bar{x}$

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

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

$f(x, y, z) = (m_0, m_1, m_3, m_4, m_5, m_6)$

11. (b)

$F = \bar{A}\bar{B}\,I_0 + \bar{A}B\,I_1 + A\bar{B}\,I_2 + AB\,I_3$

Put $I_0 = 0$, $I_1 = 1$, $I_2 = 1$, $I_3 = 0$

$F = \bar{A}B + A\bar{B}$

$F = A \oplus B$

12. (b)

$Q = \bar{A}\bar{B}C + \bar{A}B + A\bar{B} + AB$

$Q = \bar{A}(\bar{B}C + B) + A(\bar{B} + B)$

$Q = \bar{A}(\bar{B} + B)(B + C) + A\,Q$

$= A(\bar{B} + C) + A$

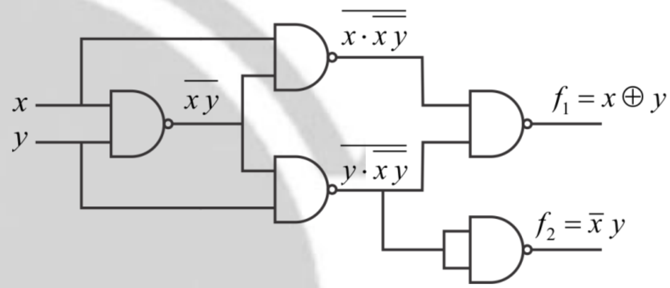
$Q = (\bar{A} + A)(A + B + C)$

$Q = A + B + C$

13. (5)

$f_1 = x\,\bar{y} + \bar{x}\,y = x \oplus y$

$f_2 = \bar{x}\,y$



Hence 5 NAND gate required.

Branch : CS & IT Batch : Hinglish

Weekly Test - 04
Digital Logic

Time Duration - 50 Min **Maximum Marks –** 20

Note : Negative Marking - 1/3, NAT no negative marking
{For MSQs no part marking no negative marking(from week onwards)}

Part A : 1 to 6 questions each will carry 1 marks (MCQs + NAT)

1. [NAT]

We have two types of digital units available:

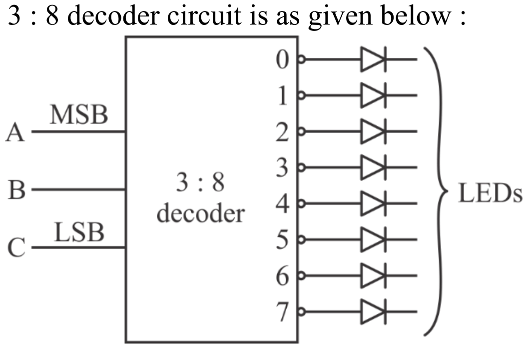
2 : 1 MUX → Cost 2 unit each

NOT gate → Cost 1 unit each

We have to implement half subtractor circuit then the minimum costing required to implement the circuit is _____ unit.

2. [NAT]

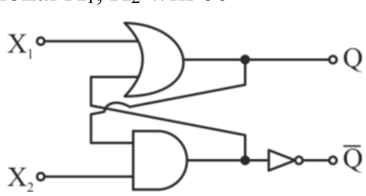
A 3 : 8 decoder circuit is as given below :



When applied input is ABC = $(110)_2$ then the sum of output pin numbers which will glow will be $(\_\_\_\_\_\_)_{10}$.

[MCQ]

3. The latching action of a latch shown below, is controlled by two inputs X_1, X_2. The invalid input combinational X_1, X_2 will be



(a) $X_1 = 1, X_2 = 0$ (b) $X_1 = 0, X_2 = 1$

(c) $X_1 = X_2 = 0$ (d) $X_1 = X_2 = 1$

4. [NAT]

Two numbers A & B are 2-bit numbers i.e. A = a_1, a_0 & B = b_1b_0. If we perform operation (A – B) using parallel subtractor with minimum no. of possible gates XOR, AND, OR, NOT etc. then minimum number of 2-input XOR gate required will be _______.

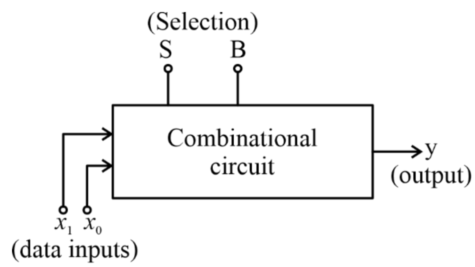
5. [MCQ]

The design of a combinational circuit is attempted as demonstrated below.

(i) For S = 0, y = 0 regardless of status of B

(ii) For S = 1 and B = 0, y = x_1

(iii) For S = 1 and B = 1, y = x_0



The minimum number count of 3-input NAND gates required to complete the design, will be

(a) 3 (b) 2

(c) 4 (d) 1

6. [NAT]

How many don't care inputs are there in a BCD adder?

Part B: 7 to 13 questions each will carry 2 marks (MCQs + NAT)

7. **[MCQ]**

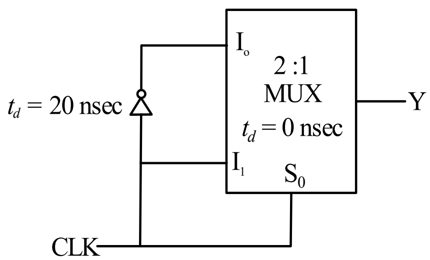
In a 4-bit carry look ahead adder, the X-OR and AND/OR gate has delay of 5ns each. The sum will appear after delay of

(a) 10 ns (b) 20 ns

(c) 15 ns (d) 40 ns

8. **[NAT]**

A MUX circuit is as shown below:

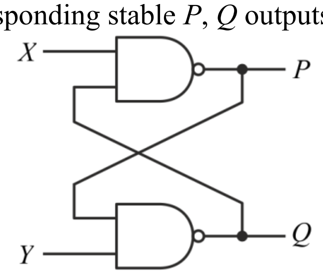


Clock input has frequency of 10 MHz, then duty cycle of the output waveform at output Y will be_________. (**up to two decimal places**).

9. The following binary values were applied to the X and Y inputs of the NAND latch shown in the figure in the sequence indicated below :

$X = 0, Y = 1; X = 0, Y = 0; X = 1, Y = 1$

The corresponding stable P, Q outputs will be



(a) $P = 1, Q = 0; P = 1, Q = 0; P = 1, Q = 0$ or $P = 1, Q = 1$

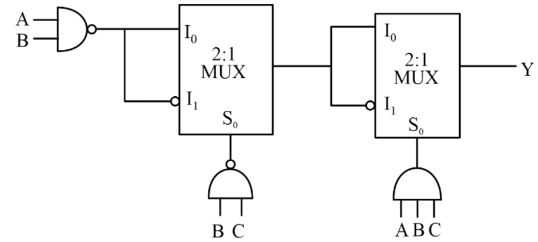
(b) $P = 1, Q = 0; P = 1, Q = 0$ or $P = 0, Q = 1$ $P = 0, Q = 1$

(c) $P = 1, Q = 0; P = 1, Q = 1;\ P = 1, Q = 0$ or $P = 0, Q = 1$

(d) $P = 1, Q = 0; P = 1, Q = 1;\ P = 1, Q = 1$

10. **[MCQ]**

A MUX circuit is designed as shown below:



What is the output Y of above combinational circuit?

(a) AB + BC + CA

(b) B (A + C)

(c) A ⊕ B ⊕ C

(d) Borrow output of full adder

11. **[NAT]**

A 16-bit parallel adder is designed using 16, 1-bit full adders. Each 1-bit full adder is designed using X-OR, AND and OR gates. The delay contributed by X-OR gate is 20ns while that contributed by AND/OR gate is 5ns. The number of additions per second that a 16-bit parallel adder can perform reliably, will be _________ $\times 10^6$

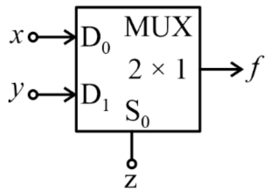
12. **[NAT]**

A designer has sufficient number of units of decoder with enable input of size 4×2^4 and a decoder of size 8×2^8 is to be realized. The number of units of 4×2^4 decoders, required will be

13. [MCQ]

Consider the configuration of a 2 × 1 MUX as shown below.

It is required to implement two variable Boolean function f = P + Q. Then



(a) x = Q, y = 1 and z = P

(b) x = Q, y = 0 and z = P

(c) x = P, y = Q and z = 0

(d) x = P, y = 0 and z = Q

Answer Key

1. (5)
2. (22)
3. (a)
4. (3)
5. (c)
6. (312)
7. (b)
8. (0.80) [Range 0.75 to 0.82]
9. (c)
10. (b)
11. (5.26) (Range 5.1 to 5.3)
12. (17)
13. (a)

CS & IT Batch : Hinglish

Weekly Test - 05
Subject : Digital Logic
Topic : Sequential Circuit

Time Duration - 50 Min **Maximum Marks –** 20

Note : Negative Marking - 1/3, NAT no negative marking
{For MSQs no part marking no negative marking(from week onwards)}

Part A : 1 to 6 questions each will carry 1 marks (MCQs + NAT)

1. If the 5-bit ripple counter and 5-bit synchronous counter are having flip-flops with a propagation delay of 40 ns, then the total sum (x + y) of maximum delay in the ripple counter (x) and synchronous counter (y) will be_____(in ns)

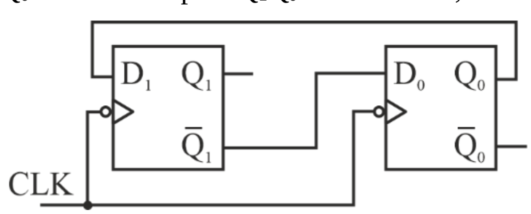
2. If the J-input of a J-K flip-flop is treated as input and an inverter is connected between J and K inputs, the J-K flip-flop becomes

(a) D Latch (b) D Flip Flop
(c) T Flip Flop (d) JK Flip Flop

3. Determine f_{max} for the 4-bit parallel carry synchronous counter, if t_{pd} for each flip-flop is 40ns and t_{pd} for each AND gate is 10ns

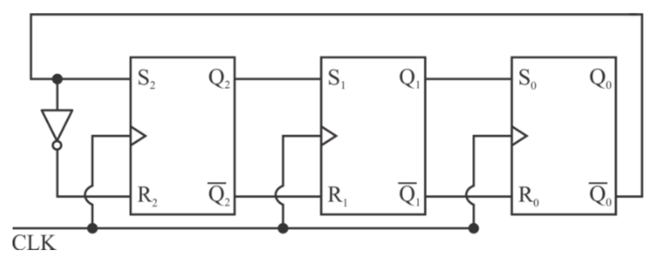
(a) 2 MHz (b) 0.2 MHz
(c) 20 MHz (d) 25 MHz

4. The two negative edge trigged D flip flops are interconnected as shown below. Assume initially Q_1Q_0=00. The outputs Q_1Q_0 of the circuit, will be

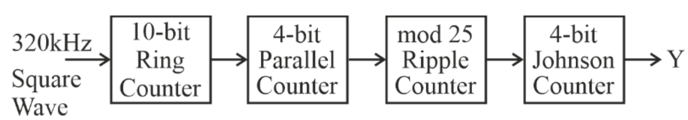


(a) 00, 01, 10, 11, 00
(b) 00, 01, 11, 10, 00
(c) 00, 11, 10, 01, 00
(d) 00, 10, 11, 01, 00

5. How many different output states the following circuit is having?



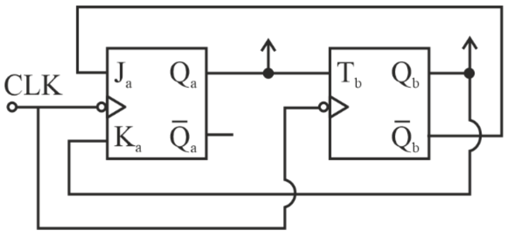
6. Various types of counters are cascaded as shown below. The signal available at output Y will have the frequency.



(a) 20Hz (b) 10Hz
(c) 320Hz (d) 160Hz

Part B: 7 to 13 questions each will carry 2 marks (MCQs + NAT)

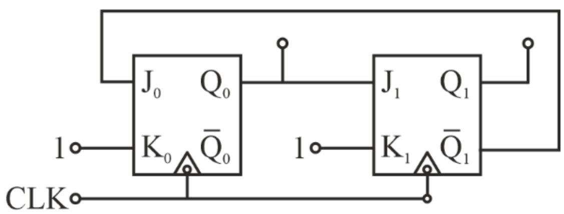
7. If the Q_a Q_b of counter shown below at clock time t_n is 10, then the state Q_a Q_b of counter at t_{n+3} (after 3 clock cycles) will be



(a) 00 (b) 01

(c) 10 (d) 11

8. Figure shows a mod-K counter, Here K is equal to



(a) 1 (b) 2

(c) 3 (d) 4

9. Consider the following conditions:

1. $t_p < \Delta t$ 2. $\Delta t < T$ 3. $t_p > \Delta t$ 4. $\Delta t < T$

Consider the following conditions:

Where t_p = pulse width, Δt = propagation delay of flip-flop and T = clock period. The race around condition in the flip-flop can be avoided if conditions_________

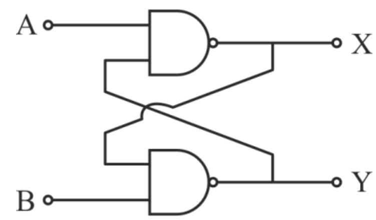
(a) 1 and 2 are correct

(b) 1, 3 and 4 are correct

(c) 2 and 3 are correct

(d) 2, 3 and 4 are correct

10. In the NAND latch shown below, initially A = B = 1 and then B is replaced by a sequence 10 10 10 ….., the outputs X and Y will be (assume initially X = 0 and Y = 1)



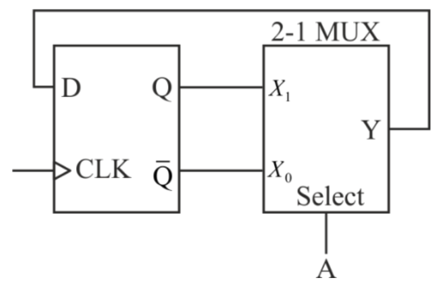
(a) fixed at 0 and 1 respectively

(b) fixed at 1 and 0 respectively

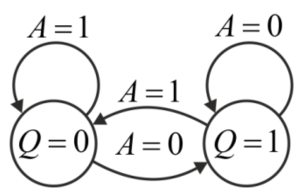
(c) X = 1010…. and Y = 0101

(d) X = 0101…. and Y = 1010

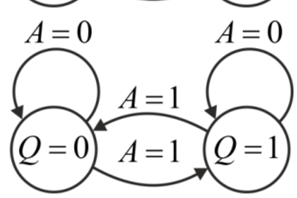
11. The state transition diagram for the logic circuit shown is



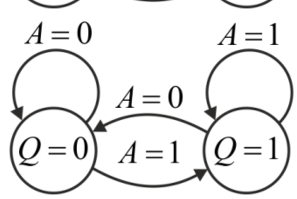
(a)



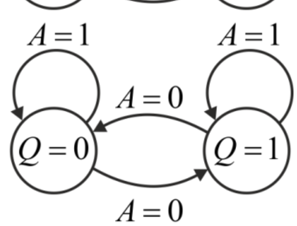
(b)



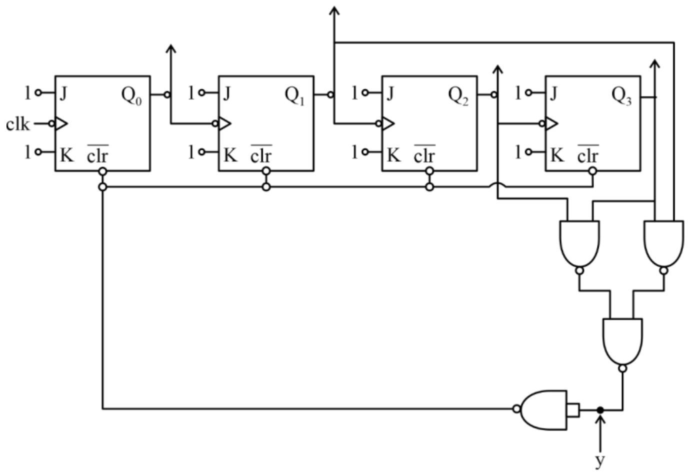
(c)



(d)



12. A circuit for truncated ripple counter together with a reset function labelled *y*, is shown below.



Then the reset function y can be expressed as

(a) $y = Q_3(Q_2 + Q_1)$

(b) $y = Q_3 + Q_2Q_1$

(c) $y = \overline{Q_3(Q_2 + Q_1)}$

(d) $y = \overline{Q_3 + Q_2Q_1}$

13. A 6 bit counter is designed with a switch *S*. Function of switch S is to switch the counter from up counter to down counter and vice-versa after MOD-no. of clock pulses irrespective of starting state of counter. Counter started with state $(101100)_2$ in up-counter mode then after how many clock-pulses it will be at $(110010)_2$ in down-mode condition of the switch ________.

Answer Key

1. (240)
2. (b)
3. (c)
4. (b)
5. (6)
6. (b)
7. (c)
8. (c)
9. (a)
10. (a)
11. (d)
12. (a)
13. (122)

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 01

Subject : Discrete Mathematics

Topic : Basics of Graphs, Degree Sequence in Graphs & Types of Graphs

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

1. Let G be a simple graph with 11 vertices. If degree of each vertex is at least 5 and at most 7, then the number of edges in G should lie between ____and ___.

(a) 29 and 39 (b) 28 and 39
(c) 28 and 38 (d) 28 and 35

2. If G be simple graph with 40 edges and degree of each vertex is 4, then number of vertices in G is ____.

3. Suppose a graph G has the degree sequence 1, 1, 2, 2, 3, 3, 3, 3, 4, 5, 5. Then find the degree sequence of the complement of G?

(a) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
(b) 5, 6, 7, 7, 7, 7, 8, 8, 9, 9, 9
(c) 5, 5, 6, 7, 7, 7, 7, 8, 8, 9, 9
(d) None of these

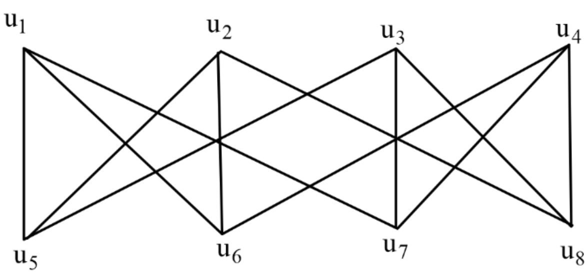
4. Suppose all vertices in a graph G have degree K, where K is an odd number, then number of vertices in G is _____.

(a) odd
(b) even
(c) a multiple of K
(d) None of these

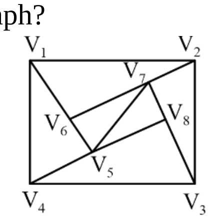
5. If G is a simple graph with degree sequence {5, 4, 4, 4, 4, 1} then number of edges in the complement $\overline{G}$ = ____.

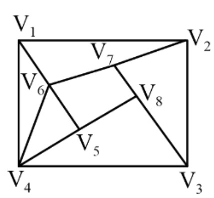
Q.6 to 10 Carry TWO Mark Each

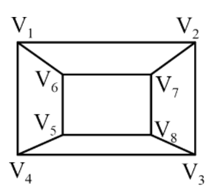
6. Consider the graph given bellows:



Which one of the following is isomorphic to the above graph?

(a)


(b)


(c)


(d) None of these

7. If W_n is a wheel graph with 'n' vertices then, the number of edge in the complement of W_n is:

(a) $\frac{n(n-3)}{2}$ (b) $\frac{n(n-2)}{2}$
(c) $\frac{(n-1)(n-3)}{2}$ (d) $\frac{(n-1)(n-4)}{2}$

8. If G is a simple graph with 6 vertices of degree 2, 3 vertices of degree 3 and 3 vertices of degree 5, then the number of edges possible in G is ____.

9. Consider a star graph with 12 edges, then the minimum and maximum degree of the complemented graph is ____.

(a) minimum = 0 and maximum = 11
(b) minimum = 0 and maximum = 10
(c) minimum = 1 and maximum = 9
(d) minimum = 1 and maximum = 8

10. Consider a graph with order 7. The degree of each vertex is defined as $\deg(V_i) = \lceil$mean of the factors of 'i'$\rceil$. Assume X is the number of edges and Y is the degree sequence of the complement of the given graph. Find X and Y?

(a) X = 10 and Y = 5, 3, 3, 3, 2, 2, 2
(b) X = 12 and Y = 5, 4, 4, 3, 3, 3, 2
(c) X = 14and Y = 5, 5, 4, 4, 4, 4, 2
(d) X = 16 and Y = 6, 5, 5, 5, 5, 3, 3

Answer Key

1. (c)
2. (20)
3. (c)
4. (b)
5. (4)
6. (c)
7. (d)
8. (18)
9. (a)
10. (b)

Hints and solutions

1. (c)

The simple graph have 11 vertices, minimum degree (δ) = 5 and maximum degree (Δ) is 7.

The relation between vertices, δ, and Δ is:

$n.\delta(G) \le 2 * |E| \le n.\Delta(G)$

$\therefore$ $11 * 5 \le 2 * |E| \le 11 * 7$

$\therefore$ $55 \le 2 * |E| \le 77$

$$\left\lceil \frac{55}{2} \right\rceil \le |E| \le \left\lfloor \frac{77}{2} \right\rfloor$$

Hence the number of edges should lie between 28 and 38.

2. (20)

Using handshaking lemma:

Sum of degrees = $2 * |E|$

Now, assume we have x number of vertices in the graph with degree of each vertex is 4.

So, $x * 4 = 2 * |E|$

$4x = 2 * 40$

$\therefore$ $x = \frac{2 * 40}{4} = 20$

Hence, the total number of vertices is 20.

3. (c)

The given graph have 11 vertices and in K_n complete graph, the degree of each vertex is $(n - 1)$ So, for K_{11} complete graph the degree of each vertex would be 10.

$\therefore$ The degree sequence of complement of G.

(10 – 1, 10 – 1, 10 – 2, 10 – 2, 10 – 3, 10 – 3, 10 – 3, 10 – 3, 10 – 4, 10 – 5, 10 – 5,)

= 9, 9, 8, 8, 7, 7, 7, 7, 6, 5, 5.

Thus, opton c is correct answer.

4. (b)

As we know that the handshaking lemma state that:

Sum of degree = $2 * |E|$

$\therefore$ $\sum$ even deg(V) + $\sum$ odd deg(V) = Even

$\therefore$ $\sum$ odd deg(V) = Even – even = Even

Hence, the number of odd degree vertices must be even to get the sum of degree as even.

5. (4)

The degree sequence of the complement graph $\overline{G}$:

K_n = 5, 5, 5, 5, 5, 5

G = 5, 4, 4, 4, 4, 1

$\overline{G}$ = 0, 1, 1, 1, 1, 4

Now, by using handshaking lemma:

Sum of degree = $2 * |E|$

$0 + 1 + 1 + 1 + 1 + 4 = 2 * |E|$

$8 = 2 * |E|$

$\therefore$ $|E| = 4$

Hence, the number of edges will be 4.

6. (c)

A graph can exist in different forms having the same number of vertices, edges and also the same degree sequence.

The given graph is bipartite graph and the option c is also bipartite graph with same number of vertices, edges and degree sequence.

Hence, option c is the isomorphic graph of the given graph G.

7. (d)

The number of edges in the complement of W_n :

Number of edges in K_n – Number of edges in W_n.

$\therefore$ $\frac{n(n-1)}{2} - 2(n-1)$

$\Rightarrow$ $\frac{n^2 - 5n + 4}{2}$

$\Rightarrow$ $\frac{(n-1)(n-4)}{2}$

Hence, option d is the correct answer.

8. (18)

By handshaking lemma:

Sum of degree = 2 ∗ |E|

$\therefore$ (6 ∗ 2) + (3 ∗ 3) + (3 ∗ 5) = 2 ∗ |E|

12 + 9 + 15 = 2 ∗ |E|

$\therefore \quad |E| = \frac{36}{2} = 18$

Hence, the number of edges is 18.

9. (a)

I. A star graph is given with 12 edges so, find the number of vertices using handshaking lemma:

Sum of degree = 2 * |E|

(n + 1) + (n –1) = 2 * |E|

$\therefore$ 2(n – 1) = 2 * 12

$\therefore$ n – 1 = 12 ⇒ n = 13

Hence, the number of vertices in star graph is 13.

II. Now, the number of edges in the completed graph will be:

$$\frac{n(n-1)}{2} - 12$$

$$\frac{13*12}{2} - 12$$

⇒ 78 – 12 = 66.

Hence, the number of edges in complement graph $\left(\overline{G}\right)$ is 66.

Now, we know that

$$n.\delta(\overline{G}) \le 2*|E| \le n.\Delta(\overline{G})$$

$$13.\delta(\overline{G}) \le 2*66 \le 13.\Delta(\overline{G})$$

$$13.\delta(\overline{G}) \le 132 \le 13.\Delta(\overline{G})$$

Hence, the minimum degree can be ‘0’ and the maximum degree will be at most 11.

10. (b)

I. The number of vertices of the graph G is 7 that is V_1, V_2, V_3, V_4, V_5, V_6, V_7.

Now, find the factors and mean for each vertex:

V_1 = Factor (1) = 1

$\therefore \quad \text{mean} = \left\lceil \frac{1}{1} \right\rceil = 1$

so, degree of V_1 = 1

V_2 = Factor (2) = 1, 2

$\therefore \quad \text{mean} = \left\lceil \frac{1+2}{2} \right\rceil = \left\lceil \frac{3}{2} \right\rceil = 2$

so, degree of V_2 = 2

V_3 = Factor (3) = 1, 3

$\therefore \quad \text{mean} = \left\lceil \frac{1+3}{2} \right\rceil = \left\lceil \frac{4}{2} \right\rceil = 2$

so, degree of V_3 = 2

Hence, degree of V_4 = 3

degree of V_5 = 3

degree of V_6 = 3

degree of V_7 = 4

II. The degree sequence for the given graph G is 4, 3, 3, 3, 2, 2, 1.

Now, the degree sequence of the complemented graph $\overline{G}$ will be as follows:

$$K_7 = 6,\ 6,\ 6,\ 6,\ 6,\ 6,6$$

$$\therefore \quad G = 4,\ 3,\ 3,\ 3,\ 2,\ 2,1$$

$$\overline{G} = 2,\ 3,\ 3,\ 3,\ 4,\ 4,\ 5$$

Hence, Y = 5, 4, 4, 3, 3, 3 2

III. To find the number of edges apply handshaking lemma:

Sum of degree = 2 ∗ |E|

$\therefore$ 5 + 4 + 4 + 3 + 3 +3 + 2 = 2 * |E|

$\therefore \quad |E| = \frac{24}{2} = 12$

Hence, X = 12.

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 02

Discrete Mathematics

Graph theory

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. Which of the following simple graphs is necessarily connected

(a) A graph with 7 vertices and 15 edges
(b) A graph with 8 vertices and 20 edges
(c) A graph with 9 vertices and 29 edges
(d) A graph with 10 vertices and 34 edges

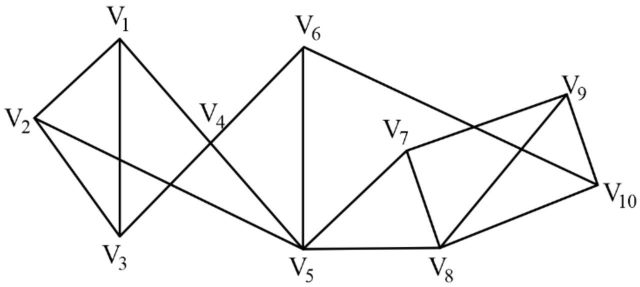
[MCQ]

2. Assume a graph G, which is simple disconnected graph with 16 vertices and the maximum number of edges are 66. Which of the following is minimum number of edges of the above graph G?

(a) 30
(b) 15
(c) 11
(d) None of these

[MCQ]

3. What is the vertex connectivity (VC) and edge connectivity (EC) of the graph shown below.



(a) VC = 1 and EC = 3
(b) VC = 2 and EC = 3
(c) VC = 3 and EC = 4
(d) VC = 4 and EC = 3

[NAT]

4. If G is a Euler graph with 11 vertices and degree of each vertex is at most 5.
The maximum number of edges possible in G is ___.

[MCQ]

5. The complete Bipartite Graph Km, n has a Hamiltonian cycle iff

(a) $m \geq 2$ and $n \geq 2$
(b) $m \geq 2$, $n \geq 2$ and $m = n$
(c) $m = n$
(d) $m \leq 2$ or $n \leq 2$

Q.6 to 10 Carry TWO Marks Each

[MCQ]

6. Consider a tree T with (n – 1) edges and n vertices. We define a term called cyclic cardinality of tree T as the number of cycles created when any two vertices of T are joined by an edge. Given a tree with 30 vertices, what is the cyclic cardinality of this tree?

(a) 30

(b) 29

(c) 435

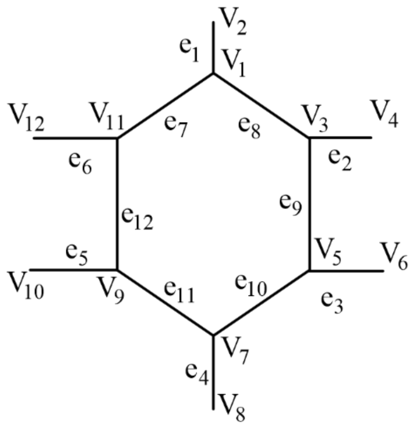
(d) 360

[NAT]

7. Let G be a simple graph with 30 vertices and 12 components. If we add an edge in G, then x is the minimum number of components and y is the maximum number of components. Find the value of x + y?

[NAT]

8. Consider the simple undirected graph G.



Find the number of cut set for the above graph G?

[MCQ]

9. Which of the following is not true?

(a) The vertex chromatic number of star graph with n vertices ($n \geq 2$) = 2.

(b) The vertex chromatic number of bipartite graph (with at least one edge) = 2.

(c) The vertex chromatic number of tree with n vertices ($n \geq 2$) = 2.

(d) If G is a simple graph in which all the cycles are of even length then the vertex chromatic number of G is 3.

[NAT]

10. If G is bipartite graph with 9 vertices and have maximum number of edges then find the chromatic number of $\overline{G}$ = ________.

Answer Key

1. (c)
2. (c)
3. (b)
4. (22)
5. (b)
6. (c)
7. (23)
8. (21)
9. (d)
10. (5)

Hints and solutions

1. (c)

A simple graph with n vertices is necessarily connected, if $|E| > \frac{(n-1)(n-2)}{2}$

$\therefore$ Only option (c) is correct.

2. (c)

In the problem we have a simple disconnected graph with 16 vertices and maximum 66 edges.

I. Now, first find the number of connected component of the graph G:

Maximum number of edges = $\frac{(n-K+1)(n-K)}{2}$

$\therefore$ $66 = \frac{(16-K+1)(16-K)}{2}$

So, by solving the above equation, we get 5 connected component.

So, K = 5.

II. Now, find the minimum number of edges possible for graph G with 16 vertices and 5 components.

$\therefore$ Minimum number of edges = n – K

= 16 – 5

= 11 edges.

Hence, we have minimum 11 edges.

3. (b)

I. The minimum degree for the given graph $\delta(G)$ is 3.

$\therefore$ $\delta(G) = 3$

II. Now, we know that the relation between the minimum degree $\delta(G)$, VC and EC is as follows:

$VC \leq EC \leq \delta(G)$

$\therefore$ $VC \leq EC \leq 3$

Form the above relation, we can conclude that the VC and EC would be less than or equal to 3.

III. Now, if we delete the vertices :

I. $\{V_2, V_4\}$ or

II. $\{V_6, V_5\}$ or

III. $\{V_5, V_{10}\}$

It will disconnect the given graph G.

Hence, the VC of the graph is 2.

IV. Now, to find the EC, try to delete the edges of minimum degree vertices.

EC = $\{(V_1, V_2), (V_2, V_3), (V_2, V_5)\}$

It will disconnect the given graph G.

Hence, the EC of the graph is 3.

4. (22)

I. A graph G is Euler graph iff it is connected and $\forall v \in G$ degree(V) = even .

Hence, the degree of each vertex will 4 that is even number.

So, the maximum number of edges possible with 11 vertices and degree of each vertex is 4.

$\therefore$ Sum of degree = 2 * |E|

$11 * 4 = 2\,|E|$

$\therefore$ $|E| = \frac{44}{2} = 22$ edges

Hence, the maximum number of edges is 22.

5. (b)

$K_{m,n}$ has Hamiltonian cycle iff m= n

($m \geq 2$ and $n \geq 2$)

6. (c)

The cyclic cardinality of a tree (T) is same as the fundamental cycle of tree T.

Now, if you select any two vertices and connect them with an edge, it will form cycle.

Hence, the cyclic cardinality = n_{c_2}

$= 30_{c_2}$

$= \frac{30 \times 29}{2}$

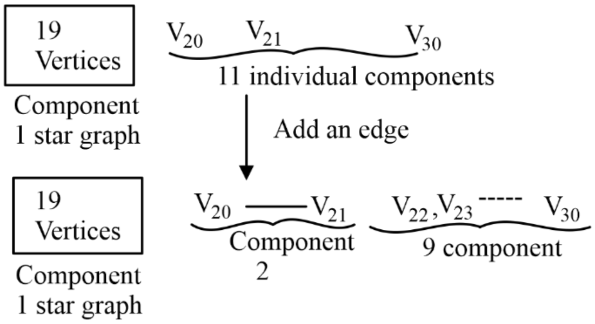
= 435

Thus, the cyclic cardinality of the tree (T) is 435.

7. (23)

I. We have 30 vertices and 12 component

Now,



So, the minimum number of components we get after adding 1 edge = 11

II. To get the maximum number of component, add the extra edge to the star graph.

So, the maximum number of components will be 12.

Thus x = 11 and y = 12

$\therefore$ x + y = 11 + 12 = 23

8. (21)

I. The vertices $\{V_2, V_4, V_6, V_8, V_{10}, V_{12}\}$ are pendant vertices. Hence, all the edges which connect the pendant vertex will be cut edge. So, the edges $\{e_1, e_2, e_3, e_4, e_5, e_6\}$ are the 6 cut set.

II. Now, in the above given graph, we have a cycle of length '6': $\{V_1 – V_3 – V_5 – V_7 – V_9 – V_{11} – V_1\}$

So, if we select any 2 edges from the cycle, it will disconnect the graph.

So, the number of cut set from the cycle

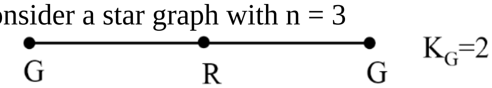
$$6_{c_2} = \frac{6 \times 5}{2} = 15$$

Hence, the total number of cut set will be 15 + 6 = 21

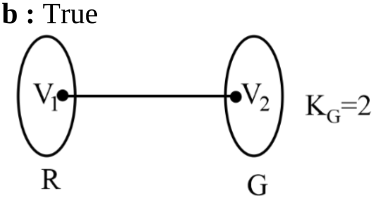
9. (d)

Option a : True

Consider a star graph with n = 3



Option b : True



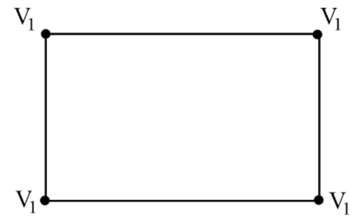
Note : A non – null graph is bipartite graph if and only if its bichromatic.

Option c : True

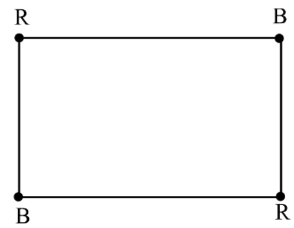
Every tree is a bipartite graph hence, it bichromatic.

Option d : False

Example



The above graph is cycle graph of even length but the vertex chromatic number is 2.



Hence, the given statement is false.

10. (5)

I. In the problem G is bipartite graph with 9 vertices.

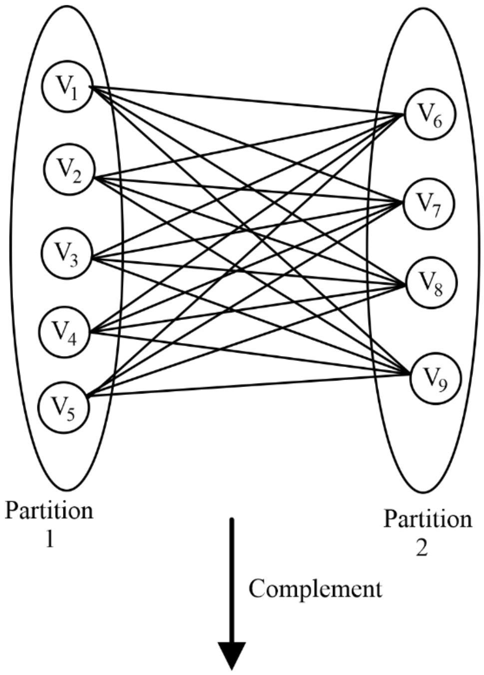
Number of vertices distribution for maximum number of edges = m + n = 5 + 4

Where m = 5 Number of vertices is partition 1

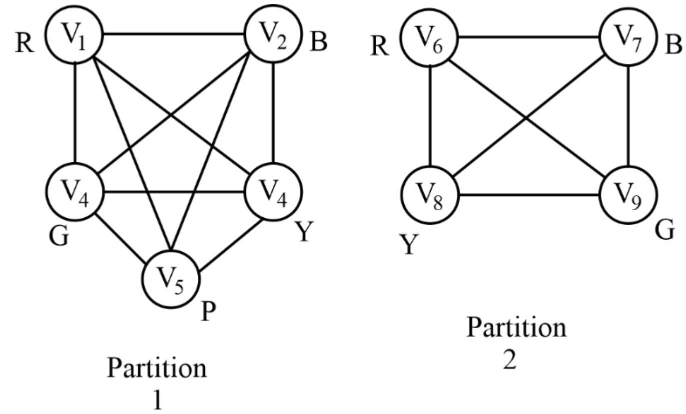
n = 4 Number of vertices is partition 2

II. The maximum number of edges of the given bipartite graph = m $*$ n

= 5 $*$ 4 = 20 edge.



The complement of the above bipartite graph will have complete graph with 5 vertices in partition 1 and complete graph with 4 vertices in partition 2.



The chromatic number of K_5 is 5.

Hence, the chromatic number of $\overline{G}$ is 5.

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 03

Subject : Discrete Mathematics

Topic : Domination Number, Matching & Planarity

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. Which of the following is not True?

(a) Number of perfect matching in $k_{2n} = \frac{(2n)!}{2^n n!}$

(b) Number of perfect matching in $K_{n,n} = n!$

(c) Number of perfect matching in C_n (n is even) = 2

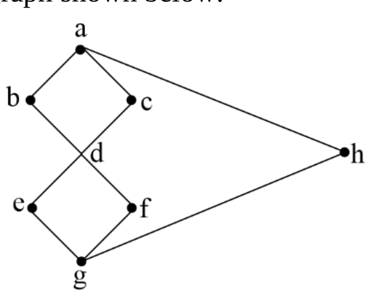
(d) Number of perfect matching in $w_{2n} = 2n$

[NAT]

2. If G is a bipartite graph with 6 vertices and maximum number of edges then find the total members of perfect matching ___?

[MSQ]

3. For the graph shown below:



Which of the following is / are True?

(a) Dominating set = {d, a, g}

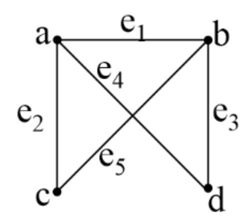
(b) Domination number is 4

(c) Dominating set = {d, h}

(d) Domination number is 2.

[NAT]

4. Number of maximal matchings in the graph shown below is ____?



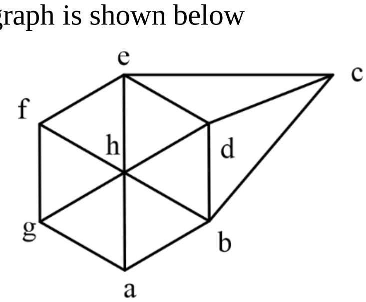
[NAT]

5. Find the total number of distinct Hamiltonian cycles for the complete graph K_5?

Q.6 to 10 Carry TWO Mark Each

[MCQ]

6. For the graph is shown below



Chromatic number of G + matching number of G = ____.

(a) 6 (b) 7

(c) 5 (d) 8

[MCQ]

7. Consider a 5-regular graph with number of vertices 10. How many closed faces are in planar embedding for connected planar?

(a) 15 (b) 16

(c) 17 (d) 18

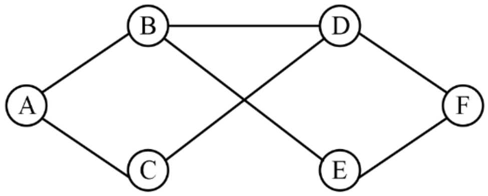
[NAT]

8. If G is a disconnected graph with 11 vertices and maximum number of edges, then matching number of G + chromatic number of G = ________ .

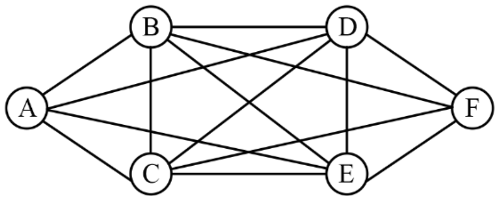
[MCQ]

9. Consider the following graphs G_1 and G_2:

G_1:



G_2:



Which of the following options are true regarding the above graphs:

(a) G_1 is planar

(b) G_2 is bipartite

(c) G_1 is planar and bipartite

(d) None of these

[MCQ]

10. Let G be a simple undirected planar graph on 20 vertices with 25 edges. If G is a connected graph, then the number of bounded forces is any embedding of G on the plane is equal to____?

(a) 3 (b) 7

(c) 5 (d) 6

Answer Key

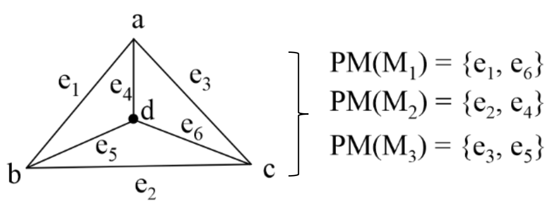
1. (d)
2. (6)
3. (a, c, d)
4. (3)
5. (12)
6. (b)
7. (b)
8. (15)
9. (c)
10. (d)

Hints and Solutions

1. (d)

The total number of perfect matchings in $w_{2n} = (2n - 1)$.

Example: $w_4 \equiv w_{2*2}$



2. (6)

A bipartite graph G is given with maximum number of edges and 6 vertices.

So, maximum number of edges possible when both partition have equal number of vertices

$\therefore$ $K_{3,3}$(Number of edges) = 3 × 3 = 9 edges

Now,

The number of perfect matchings for

$k_{3,3}$ = 3!

= 3 × 2

= 6

3. (a, c, d)

The set of vertices from which the whole graph can be covered in the single move.

So, the dominating set {d, a, g} and {d, h} are correct dominating set as it covers all the vertices of graph.

domination number of the given graph is 2, as the smallest dominating set is {d, h}.

4. (3)

Matching is a set of edges in which none of them are adjacent to each other.

$\therefore$ Maximal matching $M_1 = \{e_4, e_5\}$

$M_2 = \{e_3, e_2\}$

Hence, we have 3 maximal matching set for the given graph.

$M_3 = \{e_1\}$.

5. (12)

As we know that a graph G is Hamiltonian if and only if it contains a Hamiltonian Cycle (Closed Path) that cover every vertex exactly once.

$\therefore$ The Hamiltonian Cycle for complete graph

$$K_n = \frac{(n-1)!}{2}$$

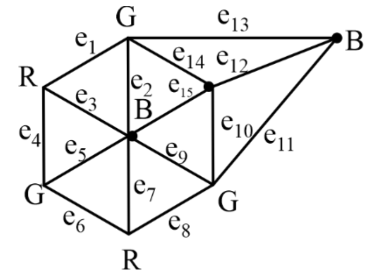
So, $$K_5 = \frac{(5-1)!}{2}$$

$$= \frac{4 \times 3 \times 2}{2}$$

$$= 12$$

6. (b)

I. The given graph has complete graph of 3 vertices (K_3) so, the chromatic number will be at least 3.



Hence, the chromatic number is 3.

II. Matching number is the cardinality of the maximum matching set.

$\therefore$ maximal matching set = $\{e_1, e_5, e_8, e_{12}\}$

Hence, the matching number of the graph is 4.

So, find value: 3 + 4 = 7

7. (b)

I: Find the total number of edges for the given 5 - regular graph with 10 vertices.

$\therefore$ Number of edges $= \frac{nk}{2} = \frac{5*10}{2}$

$= 25$ edges

II. Now, we know that for a connected planar graph, number of faces are:

$r = e - n + 2$

$\therefore\ r = 25 - 10 + 2 = 17$

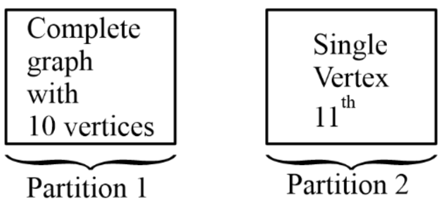
So, the total number of closed faces are = 17- 1

= 16 closed faces.

8. (15)

The given graph *G* is disconnected graph with 11 vertices and maximum edges.

So,



Now,

The chromatic number of $K_{10} = 10$

And

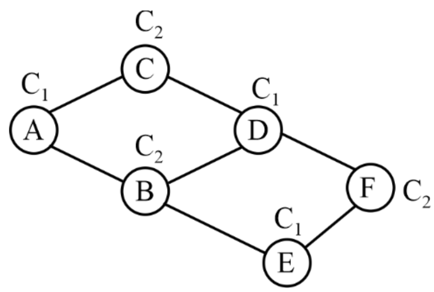
The matching number of complete graph

$$K_{10} = \left\lfloor \frac{n}{2} \right\rfloor = \left\lfloor \frac{10}{2} \right\rfloor = 5$$

$\therefore$ Final value = 5 + 10 = 15

9. (c)

G_1: The given graph is planar graph as we can flip " A — C — D" part to obtain the planar graph.



The above graph is also bipartite since we can color all the vertices with two colors.

10. (d)

For any planar graph using Euler's formula:

$V - E + R = 2$

Here V = Vertices

E = Number of edges

R = Region

$\therefore\ 20 - 25 + R = 2$

$R = 2 + 5$

$R = 7$

Hence, we have total 7 regions in the given graph, out of this, one region is unbounded and the other 6 are bounded or closed region.

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 04

Subject : Discrete Mathematics

Topic : Planarity, Propositional Logic, Logic Equivalence & Inference Rule

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. What is the inverse of the conditional statement "The home team wins whenever it is raining"

(a) If it is raining, then the home does not win.
(b) If it is not raining, then the home team does not win.
(c) If the home team does not win, then it is not raining.
(d) None of these

[MCQ]

2. Consider the following given expression

$[(p \vee q) \Rightarrow r \vee (s \Rightarrow (s \vee t))] \Rightarrow (p \vee \sim p)$

Which of the following is correct?

(a) Tautology
(b) Contradiction
(c) Contingency
(d) None

[MCQ]

3. If $p \to q$ is false then what is truth value of $\sim p \Rightarrow q \vee r$?

(a) Tautology
(b) Contradiction
(c) Contingency
(d) None

[MCQ]

4. Which of the following is logically equivalent to given expression "$(p \to r) \wedge (q \to r)$"?

(a) $(p \vee q) \to r$
(b) $(p \wedge q) \to r$
(c) $(\sim p \wedge \sim q) \to r$
(d) None of these

[NAT]

5. Consider a connected simple planar graph with order 12. Find the number of edges such that the minimum degree of graph must be 4?

Q.6 to 10 Carry TWO Mark Each

[MSQ]

6. Consider the following logical expression

$(\sim q \wedge (p \Rightarrow q)) \to \sim p$

Which of the following is True?

(a) Tautology
(b) Contradiction
(c) Satisfiable
(d) Unsatisfiable

[NAT]

7. What is the probability for a propositional function to be contingency for n variable where $n = 4$? (round off upto 2 decimal)

[MCQ]

8. The formula or logical expression is equivalent to

$[(\sim p \wedge q) \vee (p \wedge \sim q) \vee (p \wedge q)]$

(a) $p \to q$ (b) $p \wedge q$
(c) $p \leftrightarrow q$ (d) $p \vee q$

[MCQ]

9. Consider the following statements:

S₁: $(a \leftrightarrow b) \rightarrow (a \wedge b)$

S₂: $(a \leftrightarrow b) \leftrightarrow ((a \wedge b) \vee (\sim a \wedge \sim b))$

Which of the following is true?

(a) S_1 is valid

(b) S_2 is valid

(c) Both S_1 and S_2 are valid

(d) Both S_1 and S_2 are not valid

[MCQ]

10. Consider the following logical statement

"I will stay only if you go"

Which of the following is converse of the above statement? **[Gate 1998]**

(a) I do not stay follows from you do not go.

(b) I stay is necessary for you to do not go.

(c) I stay is sufficient for you to go.

(d) I stay is follows from you go.

Answer Key

1. (b)
2. (a)
3. (a)
4. (a)
5. (24)
6. (a, c)
7. (0.99 to 1)
8. (d)
9. (b)
10. (d)

Hints and Solutions

1. (b)

I. As we know that one of the way to express the conditional statement $p \to q$ is "q whenever p".

II. So, the original statement can be re-written as:
"If it is raining, then the home team wins".
Thus, the inverse of this conditional statement will be:
"It is not raining, then the home team does not win".
Hence, option b is correct.

2. (a)

The given expression is:

$$[p \vee q \Rightarrow r \vee s \Rightarrow s \vee t] \Rightarrow \underbrace{(p \vee \sim p)}_{\text{It will always generate 1}}$$

$$\therefore \overline{[p \vee q \Rightarrow r \vee s \Rightarrow s \vee t]} + (p + \sim p)$$

$$= \overline{[p \vee q \Rightarrow r \vee s \Rightarrow s \vee t]} + 1 \equiv 1$$

Hence, it is tautology.

3. (a)

As we know that the conditional statement "$p \to q$" is false when "$p = 1, q = 0$"
So, if we substitute the value of p and q then:

$$\sim p \Rightarrow q \vee r$$
$$= \sim(\sim p) + q + r$$
$$= p + q + r$$
$$= 1 + 0 + r \equiv 1$$

Hence, the truth value for the given expression is 1 and it is tautology.

4. (a)

Two statements forms are logical equivalent if and only if their resulting truth values are identical for each variation of statement variables..

So, $(p \to r) \wedge (q \to r)$

$$= (\bar{p} + r) \wedge (\bar{q} + r)$$
$$= \bar{p}\,\bar{q} + \bar{p}r + \bar{q}r + r$$
$$= \bar{p}\,\bar{q} + \bar{p}r + r$$
$$= \bar{p}\,\bar{q} + r$$
$$= \overline{(p \vee q)} + r \equiv (p \vee q) \to r$$

Hence, option a is logically equivalence to given statement.

5. (24)

I. As we know that the connected simple planar graph with 12 vertices can have at most "$3n - 6$" edges.

$\therefore$ No. of edges $\leq 3n - 6$

$$\leq 3 * 12 - 6$$
$$\leq 36 - 6$$
$$\leq 30$$

So, the number of edges must be less than or equal to 30.

II. Now, the relation between the minimum degree and number of edges is:

$$\delta(G) = \frac{2 * |E|}{n}$$

$$\delta(G) = \frac{2 * |E|}{12}$$

$$4 = \frac{2 * |E|}{12}$$

$$\therefore \quad |E| = \frac{12 * 4}{2} = 24 \text{ edges}$$

So, to get the minimum degree 4, the number of edges will be 24.

6. (a, c)

The given logical expression is:

$$(\sim q \wedge (p \to q) \to \sim p)$$
$$= (\bar{q} \cdot (\bar{p} + q)) \to \bar{p}$$
$$= (\bar{q}\,\bar{p} + \bar{q}q) \to \bar{p}$$
$$= (\bar{q}\,\bar{p} + 0) \to \bar{p}$$
$$= (\bar{q}\,\bar{p}) \to \bar{p}$$
$$= \overline{\bar{q}\,\bar{p}} + \bar{p}$$
$$= q + p + \bar{p}$$
$$= q + 1 \equiv 1$$

Hence, the given expression is tautolgy and every tautology is satisfiable.
So, option a and c are correct.

7. (0.99 to 1)
We know that the total number of contingency possible for n variable function is $2^{2^n} - 2$
So, the number of contigency for $n = 4$:
$$2^{2^n} - 2 = 2^{2^4} - 2 = 65536 - 2 = 65534$$
Now, probability $= \dfrac{\text{Total number of contigency}}{\text{Total functions}}$
$$= \frac{2^{2^n} - 2}{2^{2^n}} = \frac{65534}{65536}$$
$$= 0.99$$

8. (d)
$$[\bar{p}q + p\bar{q} + pq]$$
$$= [\bar{p}q + p(\bar{q} + q)]$$
$$= [\bar{p}q + p]$$
$$= [p \vee q]$$
Hence, option D is correct.

9. (b)
Statement S_1: Not valid
$$(a \leftrightarrow b) \rightarrow (a \wedge b)$$
$$= (\bar{a}\,\bar{b} + ab) \rightarrow ab$$
$$= \overline{(\bar{a}\,\bar{b} + ab)} + ab$$
$$= [(a + b)(\bar{a} + \bar{b})] + ab$$
$$= b\bar{a} + a\bar{b} + ab$$
$$= b\bar{a} + a(\bar{b} + b)$$
$$= b\bar{a} + a$$
$$= b + a \neq 1$$
Hence, it is not valid.
Statement S_2: valid
$$(a \leftrightarrow b) \leftrightarrow \big((a \wedge b) \vee (\sim a \wedge \sim b)\big)$$
$$(\bar{a}\,\bar{b} + ab) \leftrightarrow (ab + \bar{a}\,\bar{b})$$
$$T \Leftrightarrow T \equiv 1$$
Hence, S_2 is valid.

10. (d)
As we know that some of the way to express the conditional statement $p \rightarrow q$ are:
(i) q follows from p
(ii) q is necessary for p
(iii) p is sufficient for q
Hence, the logical equivalence for each option is as follows:
Option a: $\sim q \rightarrow \sim p$
Option b: $\sim q \rightarrow p$
Option c: $p \rightarrow q$
Option d: $q \rightarrow p$
So, option d is the converse of the given logical statement.

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 05

Subject : Discrete Mathematics

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

1. Consider the following statements:
S_1: $[(p \wedge \sim q) \to r] \to [p \to (q \vee r)]$
S_2: $[(p \to q) \wedge (r \to s) \wedge (p \vee r)] \to (q \vee s)$
Which of the following is true?
(a) S_1 is valid and S_2 is not valid
(b) S_2 is valid and S_1 is not valid
(c) Both S_1 and S_2 are valid
(d) Neither S_1 nor S_2 is valid

2. $\{(p \to \neg q) \wedge (r \to q) \wedge r\} \to p$ is
(a) Tautology (b) Contingency
(c) Contradiction (d) None

3. $\neg (S \leftrightarrow (P \to S))$ is
(a) Tautology (b) Contingency
(c) Contradiction (d) Can't be determined

4. The game of logic has 2 assumptions
1. Logic is difficult or not many students like logic.
2. If mathematics is easy, then logic is not difficult.
Which of the following is conclusion for the given assumption?
(a) Mathematics is not easy, if many students like logic
(b) Not many students like logic, if mathematics is not easy
(c) Mathematics is not easy or logic is difficult
(d) None of the above

5. P: $\neg(A \wedge B) \vee (\neg A \to B)$ is
(a) Tautology (b) Contingency
(c) Contradiction (d) Can't be determined.

Q.6 to 10 Carry TWO Marks Each

6. $(p \to (q \to r)) \leftrightarrow ((p \to q) \to r)$ is
(a) Tautology (b) Contingency
(c) Contradiction (d) Can's be determined.

7. Which of the following statements are True?
(a) $(P \to Q) \vee (Q \to P)$ is always True
(b) $(P \to Q) \vee (Q \to R)$ is always True
(c) $(P \to Q) \vee (\neg P \to R)$ is always True
(d) $(P \to Q) \vee (R \to Q)$ is always True

8. Suppose $P \to \neg q$ is false.
What is number of all possible combinations of truth value of r and s for which $(\neg q \to r) \wedge (\neg p \vee s)$ is true?

9. Which of the following is not true?
(a) $\exists x \exists y\, [(2x + y = 5) \wedge (x - 3y = -8)]$
(b) $\exists x \exists y\, [xy = 1]$
(c) $\exists x \forall y\, [xy = 1]$
(d) None

10. p(x): $x^2 - 8x + 15 = 0$
q(x): x is odd
r(x): $x > 0$
Which of the following is true?
(a) $\exists x[p(x) \to q(x)]$
(b) $\forall x[q(x) \to p(x)]$
(c) $\exists x[r(x) \to p(x)]$
(d) $\forall x[p(x) \to q(x)]$

Answer Key

1. (c)
2. (b)
3. (b)
4. (a)
5. (a)
6. (c)
7. (a, b, c)
8. (2)
9. (c)
10. (a, c)

Hints and solutions

1. (c)

both are true

S_1:

pqr	$[p \rightarrow (q \vee r)]$	$p \wedge \sim q$	$[(p \wedge \sim q) \rightarrow r]$	$[(p \wedge \sim q) \rightarrow r] \rightarrow [p \rightarrow (q \vee r)]$
TFF	F	T	F	T

S_2: 2 times disjunctive syllogism

2. (b)

$\{(p \rightarrow \neg q) \wedge (r \rightarrow q) \wedge r\} \rightarrow p$

$\left.\begin{array}{l} p = F \\ q = \\ r = T \end{array}\right\}$ Output is dependent on q

$q = T \Rightarrow o/p = T$

$q = F \Rightarrow o/p = F$

$\therefore$ Contingency

3. (b)

P	S	P → S	x: S↔P→S	¬x
T	T	T	T	F
T	F	F	T	F
F	T	T	T	F
F	F	T	F	T

4. (a)

(a) "Mathematics is not easy, if many students like logic" can be represented mathematically as $q \rightarrow \neg r$. We note that the proposition $q \rightarrow \neg$ r is logical equivalence, thus the conclusion is valid.

5. (a)

$(\neg A \vee \neg B) \vee (\neg A \vee B)$

$\neg A \vee \underbrace{\neg B \vee \neg A \vee B}$

$\neg A \vee \quad 1 \quad = 1$

6. (c)

Assume RHS = F, LHS becomes T

$(p \rightarrow (q \rightarrow r)) \leftrightarrow ((p \rightarrow q) \rightarrow r)$

T (above $p \rightarrow q$), F (above r)

T F F T F

T

$T \leftrightarrow F \Rightarrow F$

7. (a, b, c)

(d) $(P \rightarrow Q) \vee (R \rightarrow Q)$ is always True

T F $\vee$ T F

$F \vee F = F$

(a) $(P \rightarrow Q) \vee (Q \rightarrow P)$ P = T, Q = F

F F T = T

T

(c) $(P \rightarrow Q) \vee (Q \rightarrow R)$

If Q is true, $P \rightarrow Q$ can never be false

If Q is false, $Q \rightarrow R$ can never be false

(d) $(P \rightarrow Q) \vee (\neg P \rightarrow R)$

$\underbrace{\neg P \vee Q \vee P} \vee R$

$1 \vee Q \vee R = 1$

8. (2

)

$p \rightarrow \neg q$ is false

p = T

$\neg q = F \Rightarrow q = T$

9. (c)

(a) $\left.\begin{array}{l} x = 1 \\ y = 3 \end{array}\right\}$ $\left.\begin{array}{l} 2x + y = 2 * 1 + 3 = 5 \\ x - 3y = 1 * 1 - 3 * 3 = -8 \end{array}\right\}$ True

(b) $\left.\begin{array}{l} x = 1 \text{ There exists atleast} \\ y = 1 \text{ One value which makes } xy = 1 \end{array}\right\}$ True

(c) False, Not valid for all

10. (a, c)

(a) $\exists x[p(x) \rightarrow q(x)] \Rightarrow x = 5, 3$

(b) $\forall x[q(x) \rightarrow p(x)] \Rightarrow x = 7 \Rightarrow q(x) = \text{true}, p(x) =$ False $\therefore$ (b) is false

(c) $\exists x[r(x) \rightarrow p(x)] \Rightarrow x = 5, 3$

(d) $\forall x[p(x) \rightarrow q(x)$

Branch : CSE/IT Batch : Hinglish

WEEKLY TEST – 06

Subject : Discrete Mathematics

Topic : Set Theory

Maximum Marks 17

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. If A is a proper sub set of B, then which of the following statements is not true

(a) $A \cap B = A$ (b) $B^C \subset A^C$

(c) $B \cup A^C = U$ (d) $B - A = \varnothing$

[MCQ]

2. The poset [{2, 3, 5, 30, 60, 120, 180, 360}] is

(a) a lattice

(b) a join semi lattice

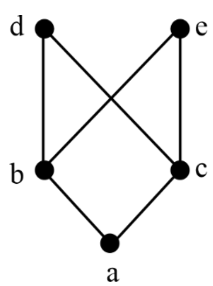
(c) a meet semi lattice

(d) neither a join semi lattice nor a meet semi lattice

[MCQ]

3. Consider the poset:

P = {a, b, c, d, e} shown below



Which of the following statements is false?

(a) P is not a lattice

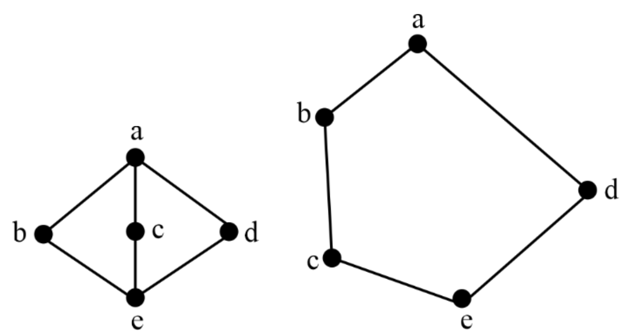
(b) The sub set {a, b, c, d} of P is a lattice

(c) The sub set {b, c, d, e} of P is a lattice

(d) The sub set {a, b, c, e} of P is a lattice

[MCQ]

4. Consider the following Lattices L_1* and L_2*



Which of the following is true?

(a) L_1* is distributive and L_2* is distributive

(b) L_1* is not distributive and L_2* is distributive

(c) Both Lattices are distributive

(d) Both Lattices are non-distributive

[MCQ]

5. The set of all strings under the operation concatenation of strings is

(a) a monoid but not a group

(b) an abelian group

(c) a group but not a abelian group

(d) not a semi group

Q.6 to 11 Carry TWO Mark Each

[MCQ]

6. If (G, *) is a group then which of the following is false

(a) $\{(a * b) = (a * c)\} \Rightarrow (b = c)$

(b) $\{(a * c) = (b * c)\} \Rightarrow (a = b)$

(c) $a * b = b * a$

(d) $(a * b)^{-1} = (b^{-1} * a^{-1})$

[MCQ]

7. Which of the following is false?

(a) A cyclic group with only one generator can have atmost 2 elements

(b) The order of a cyclic group is equal to the order of its generator

(c) The group $(\{1, 2, 3, 4\}, \otimes_5)$ is cyclic

(d) A group of order 4 is cyclic

[MCQ]

8. Let G be a reduced residue system modulo is say G = {1, 2, 4, 7, 8, 11, 13, 14} (i.e. the set of integers between 1 and 15 which are coprime to 15). Then G is a group under multiplication modulo 15. Which of the following is false

(a) inverse of 2 = 8

(b) inverse of 7 = 13

(c) inverse of 11 = 11

(d) inverse of 4 = 9

[MCQ]

9. If $X = \{x \mid x \text{ is a multiple of } 4\}$ and $Y = \{y \mid y \text{ is a multiple of } 6\}$. If $Z = X \cup Y$ and $z \in Z$ then z is a multiple of ______.

(a) 4 (b) 6

(c) 12 (d) 2

[MCQ]

10. Let 'A' is set of all non zero real numbers. For a, b $\in$ A, a relation R on A is defined as "$a \; R \; b$ iff $\frac{a}{b} \in Q$" where Q is set of all rational numbers. Then 'R' is ______.

(a) An equivalence relation

(b) A partial ordering relation

(c) Symmetric but not transitive

(d) Transitive but not symmetric

[MCQ]

11. Let A = {1, 2, 3, 4} and R = {(1, 2), (2, 3), (3, 4), (2, 1)} be a relation on A. The transitive closure of R is _____.

(a) $A \times A$

(b) {(1, 1), (1, 2), (1, 3), (1, 4), (2, 1), (2, 2), (2, 3), (2, 4), (3, 4)}

(c) $R \cup R^{-1}$

(d) $R \cup \Delta_A$

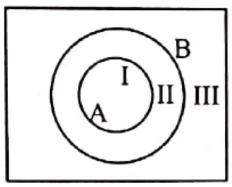
Answer Key

1. (d)
2. (c)
3. (c)
4. (d)
5. (a)
6. (c)
7. (d)
8. (d)
9. (d)
10. (a)
11. (b)

Hints and Solutions

1. **(d)**

The venn diagram to represent $A \subset B$ is



(a) $A \;\; B = \{I\} \cap \{I, II\} = \{I\} = A$

(b) $B^c = \{III\}$ and $A^c = \{II, III\}$

$\therefore B^c \subset A^c$

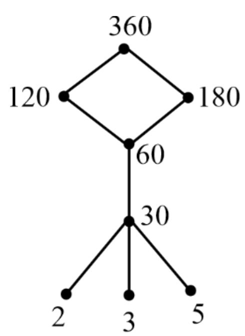
(c) $B \cup A^c = \{I, II\} \cup \{II, II\} = \{I, II, III\} = U$

(d) $B - A = \{II\} = \phi$

The statement (d) is false.

2. **(c)**

The hasse diagram of the poset is shown below



We have 3 minimal elements 2, 3 and 5.

For any two minimal elements glb does not exist.

$\therefore$ The given poset is not a meet semi lattice.

However, for every pair of elements in the poset, lub exists.

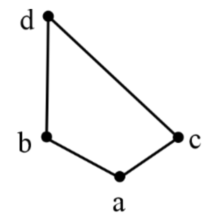
Hence, the poset is a join semi lattice.

3. **(c)**

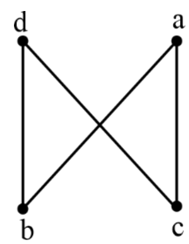
(a) The least upper bound of c and d does not exist.

$\therefore$ P is not a lattice.

(b) The subset {a, b, c, d} of P is a lattice whose Hasses diagram is shown below.



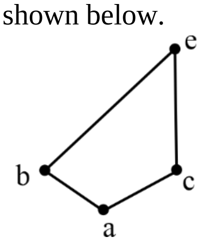
(c) The Hasses diagram of the subset {b, c, d, e} is shown below



We have, two minimal elements and two maximal elements.

$\therefore$ The poset is not a lattice.

(d) The subset {a, b, c, e} of P is a lattice whose Hasse diagram is shown below.



4. **(d)**

In the lattice L_1^*. The element b has two complements c and d.

$\therefore L_1^*$ is not a distributive lattice

In the lattice L_2^*, the element d has two complements b and c.

$\therefore L_2^*$ is not a distributive lattice

5. **(a)**

Let S = set of all bit strings and + denote string concatenation.

(i) concatenation of any two bit strings is also a bit string.

$\therefore$ + is a closed a closed operation on S.

(ii) string concatenatenation is associative

i.e., $(S_1 + S_2) + S_3 = S_1 + (S_2 + S_3)$

$\therefore$ + is associative on S.

(iii) The identity element of S with respect to + is the null string $\in$

(iv) The inverse of a non empty string does not exist with respect to +.

$\therefore$ (S, +) is a monoid but not a group

6. (c)

(a) Let $a * b = a * c$

$\Rightarrow$ $a^{-1} * (a * b) = a^{-1} * (a * c)$

$\Rightarrow$ $(a^{-1} *) * b = (a^{-1} * a) * c$

$\Rightarrow$ $e * b = e * c$

$\Rightarrow$ $b = c$

(b) Let $(a * c) = (b * c)$

$\Rightarrow$ $(a * c) * c^{-1} = (b * c) * c^{-1}$

$\Rightarrow$ $a*(c*c^{-1}) = b * (c * c^{-1})$

$\Rightarrow$ $a * e = b * e$

$\Rightarrow$ $a = b$

(c) (G, *) need not be an abelian group.

$\therefore$ option (c) is false.

(d) Consider $(a * b)*(b^{-1} * a^{-1})$

$= a*(b * b^{-1}) * a^{-1}$ (by associativity)

$= a*e*a^{-1} = a * a^{-1}$

$= e$

Similarly, $(b^{-1} * a^{-1})*(a*b) = e$

$\therefore$ $(a*b)^{-1} = b^{-1} * a^{-1}$

7. (d)

G = {1, 3, 5, 7} is a group with respect to $\otimes_8$.

G is not cyclic, because the generating element does not exist.

8. (d)

(a) $2 \otimes_{15} 8 = 1$(identity element)
$\therefore$ Inverse of 2 is 8

(b) $7 \otimes_{15} 13 = 1$(identity element)
$\therefore$ Inverse of 7 is 13

(c) $11 \otimes_{15} 11 = 1$(identity element)
$\therefore$ Inverse of 11 is 11

(d) $4 \otimes_{15} 9 = 6$
$\therefore$ Inverse of 4 is 9.

Inverse of 4 = 4 ($\therefore$ $4 \otimes_{15} 4 = 1$)

9. (d)

Z = {4, 8, 12, 16,….6, 12, 18, 24, ….}

If $z \in Z$ then z is a multiple of 2, because z is a common divisor of 4 and 6.

10. (a)

A = R – {0}

$(a^R b) \Leftrightarrow \frac{a}{b}$ is a relational number

(a) $\frac{a}{a} = 1 \ (a \neq 0)$

$\Rightarrow a^R a \quad \forall \ a \in$

$\therefore$ r is reflexive

If $\frac{a}{b}$ = Rational number, then

$\frac{b}{a}$ = Rational number

$\therefore$ R is symmetric

Let $(a^R b)$ and $(b^R c)$

$\Rightarrow \left(\frac{a}{b}\right)$ and $\left(\frac{b}{c}\right)$ are rational number

$\frac{a}{c} = \left(\frac{a}{b}\right)\left(\frac{b}{c}\right) \in Q$

Q means set of all rational numbers

$\therefore$ R is transitive

(b) R is not anti-symmetric.

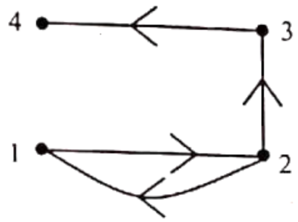
Ex: 2 R 3 and 3 R 2

$\therefore$ R is not a partial order

Options (c) and (b) are false.

11. (b)

The relation can be denoted buy the following diagram



From vertex 1, there is a path to all other vertices.

From vertex 2, there is a path to all other vertices.

From vertex 3, we can reach only vertex 4.

From vertex 4, there is not path to other vertices.

Transitive closing of R

= {(1, 1), (1, 2), (1, 3), (1, 4), (2, 1), (2, 2), (2, 3), (2, 4), (3, 4)}

Branch : CSE/IT **Batch :Hinglish**

WEEKLY TEST – 7

Subject : Discrete Mathematics

Topic : Combinatorics

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[NAT]

1. A team of 11 is to be selected out of 15 players of whom 6 are bowlers. Find the number of ways in which this can be done so as to include at least 5 bowlers.

[MCQ]

2. The number of ways in which 9 boys can be arranged at a round table if two particular boys should never sit together?

(a) 120 (b) 5040

(c) 40320 (d) 30240

[NAT]

3. How many odd numbers having four digits, without repetition can be formed from the set of whole numbers?

[NAT]

4. How many integers are there in the set {1, 2, 3, …, 1000} with no digit being repeated.

[MCQ]

5. In how many ways can 3 prizes be given to the top 3 players in a game played by 11 players?

(a) $^{11}C_3$

(b) 11! * 3!

(c) 990

(d) $^{8}C_3$

Q.6 to 10 Carry TWO Mark Each

6. **[NAT]**

How many distinct license plates are possible in the given format: 2 alphabets, followed by four digits. [Example AB6672]

7. **[MCQ]**

In how many ways can we choose 5 different flavors of ice-creme from 9 different flavors?

(a) $\frac{13!}{5!8!}$ (b) $\frac{13!}{5!}$

(c) 13! (d) $\frac{13!}{8!}$

8. **[NAT]**

In how many different ways can the letters in the word "macro" be arranged if it always has to start with a vowel? (without repetition of letters)

9. **[NAT]**

24 people exchange cards at a meeting. Hour many cards are exchanged if everyone greets each other with a card once?

10. **[MCQ]**

How many lottery tickets must be purchased to complete all possible combinations of 7 numbers each with a possibility of being from 1 to 48?

(a) 76329072
(b) 73629072
(c) 71131278
(d) 73692072

Answer Key

1. **(630)**
2. **(d)**
3. **(1680)**
4. **(585)**
5. **(c)**
6. **(6760000)**
7. **(a)**
8. **(12)**
9. **(276)**
10. **(b)**

Hints and Solutions

1. (630)

The number of ways to find atleast 5 bowlers:-

${}^6C_5 * {}^9C_6 + {}^6C_6 * {}^9C_5$

$$\frac{6\times 5!}{5!} * \frac{9\times 8\times 7\times 6!}{3!\times 6!} + \frac{6!}{6!} * \frac{9\times 8\times 7\times 6\times 5!}{4\times 3\times 2\times 1\times 5!}$$

$6 * 3 * 4 * 7 + 9 * 7 * 2$

$6 * 12 * 7 + 9 * 14$

$504 + 126 = 630.$

2. (d)

- Number of ways of arranging 9 boys around a round table is $(9 - 1) = 8!$
- Number of ways such that two particular boys always sit together $= (9 - 2)! * 2! \rightarrow 7! * 2!$
- Number of ways such that two particular boys never sit together $\Rightarrow 8! - 7! * 2!$

$= 8 * 7! - 7! * 2$

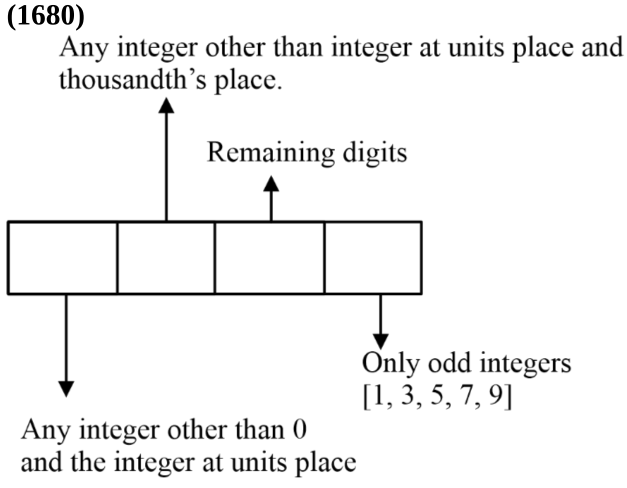
$= 7!\,[8 - 2]$

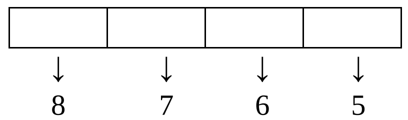
$\Rightarrow 7! * 6$

$\Rightarrow 5040 * 6$

$\Rightarrow 30240$

3. (1680)





Total possible four-digit distinct odd numbers

$= 8 \times 7 \times 6 \times 5 = 1680$

4. (585)

One digit = 9 possiblity

Two digit = 9 * 8 possiblity

Three digit = 9 * 8 * 7 possiblity

$9 + 9 * 8 + 9 * 8 * 7$

$\Rightarrow 9 + 72 + 504$

$\Rightarrow 585$

5. (c)

Winner 1 can be prized in 11 different ways, after first winner 2nd and 3rd winners can also be prized in 10 and 9 different ways.

So total possible ways

$\Rightarrow 11 * 10 * 9 = 990$

6. (6760000)

Sol: For alphabets possibilities for each of the two letters =26

For each of the four digits possibilities =10.

Total number of possibilities $= 26 * 26 * 10 * 10 * 10 * 10 = 6760000$

7. (a)

Sol: Total number of ice-creme flavors $\Rightarrow 9(n)$.

Total number of ice -creme flavors to be selected = 5(r).

$$C(n, r) \Rightarrow \frac{(r+n-1)!}{r!(n-1)!}$$

$$\Rightarrow \frac{(5+9-1)!}{5!(9-1)!}$$

$$\Rightarrow \frac{13!}{5!8!} = 1188$$

8. (12)

Sol: The words will begin with ' a ' ar ' o ' followed by. remaining 3 letters.

$2! * 3! \Rightarrow 2 * 3 * 2 * 1 = 12$

9. (276)

Sol: The cards can be exchanged in ${}^{24}C_2$ ways

$$24_{C_2} \Rightarrow \frac{24 \times 23 \times 22!}{22! \times 2} = 276$$

10. (b)

Sol: $48_{C_7} = \frac{48!}{7! \times 41!}$

$\Rightarrow 73629072$

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 01

Subject : Operating System

Topic : Intro and Background, Process Management & CPU Scheduling

Maximum Marks 20

Q.1 to 6 Carry ONE Mark Each

[MSQ]

1. Which of the following is/are example of Hard real time operating system?

(a) Satellite Launch

(b) Missile Control System

(c) DVD player

(d) Air Traffic Control

[NAT]

2. How many of the following is/are privileged instruction?

i. Set value of timer.
ii. Access I/O device.
iii. Issue a trap instruction.
iv. Switch from user to kernel mode.
v. Switch from kernel to user mode
vi. Modify entries in device-status table.
vii. Read the clock.
viii. Clear memory.
ix. Turn off interrupts

[MSQ]

3. Which of the following is/are correct?

(a) User processes can only be executed when mode bit is 0.

(b) User processes can only be executed when mode bit is 1.

(c) Kernel processes can only be executed when mode bit is 0.

(d) Kernel processes can only be executed when mode bit is 1.

[MSQ]

4. Which of the following is/are correct?

(a) Mode shifting is required to switch from User mode to Kernel mode.

(b) Mode shifting is required to switch from Kernel mode to User mode.

(c) Interrupt is raised to change mode bit 1 to 0.

(d) Interrupt is raised to change mode bit 0 to 1.

[MCQ]

5. Which of the following process state is not present in uni-programmed OS?

(a) New state (b) Ready State

(c) Block state (d) Suspend state

[NAT]

6. Consider a scenario, in a multi-programmed OS, a process A is running in non-pre-emptive mode, another process B with high priority arrives. How many of the following scenarios are possible?

(i) Process A will move from Ready to Running state.

(ii) Process B will move from Ready to Running state.

(iii) Process A will be blocked till the time Process B is in running state.

(iv) Process A will move to Ready state from running state till the time process B is in running state.

(v) Process B will move from Block state to Running state.

Q.7 to 13 Carry TWO Mark Each

[MCQ]

7. Which of the following scheduler plays major role in time-shared operating system?
(a) Long Term Scheduler
(b) Medium Term Scheduler
(c) Short Term Scheduler
(d) All of these have equal role in Time-shared OS.

[NAT]

8. Consider the following processes, scheduled as per First come first serve scheduling algorithm?

Process	Arrival Time	Burst Time
P1	10	4
P2	5	6
P3	6	1
P4	1	2

Suppose X is the number of context switches including context switch for first and last process, Y is the total time CPU remain idle, and Z is the total waiting time. Calculate (X*Y)+Z?

[MCQ]

9. Consider the following processes, scheduled as per Shortest Job first scheduling algorithm?

Process	Arrival Time	Burst Time
P1	0	8
P2	4	5
P3	6	3
P4	8	2

Calculate the difference between average turnaround time and average waiting time?
(a) 3.25 (b) 4.5
(c) 6.25 (d) 7.5

[MCQ]

10. Consider the following processes, scheduled as per Shortest remaining time first.

Process	Arrival Time	Burst Time
P1	0	5 ms
P2	3	1 ms
P3	5	3 ms
P4	7	6 ms
P5	4	2 ms

Calculate the average waiting time?

Note: If two process has equal remaining burst time then they will be scheduled as per first come first serve basis.

(a) 3 (b) 3.25
(c) 2 (d) 2.25

[MSQ]

11. Which of the following is/are incorrect statements?
(a) SJF gives the optimal average turnaround time among all scheduling algorithms.
(b) FCFS may suffer from starvation.
(c) SJF may suffer from starvation.
(d) SRTF do not have starvation.

[MCQ]

12. Which of the following pre-emptive scheduling algorithm suffers from convoy effect?
(a) FCFS
(b) SJF
(c) SRTF
(d) None of the above

[MSQ]

13. Which of the following scheduling queue is/are present in main memory?
(a) Ready queue
(b) Block queue
(c) Device queue
(d) Input queue

Answer Key

1. (a, b, d)
2. (7)
3. (b, c)
4. (a, b, c)
5. (b)
6. (0)
7. (c)
8. (25)
9. (b)
10. (c)
11. (b, d)
12. (d)
13. (a, b)

Hints and Solutions

1. (a, b, d)

In hard real time OS, a millisecond of delay can cause huge loss, the system where human lives and huge risks are involved are considered as the part of Hard RTOS. Therefore, satellite launch, missile control system, air traffic control, fire alarm system, heart pacemakers, etc. is Hard RTOS, whereas DVD player is an example of soft real time OS.

2. (7)

Privileged instructions are:

Set the value of the timer

Access I/O device

Switch from user to kernel mode

Switch from kernel to user mode

Modify entries in the device-status table

Clear memory

Turn off interrupts

Non- privileged instructions are:

Issue a trap instruction

Read the clock

3. (b, c)

Mode bit in User mode= 1

Mode bit in Kernel mode= 0.

So, User processes can only be executed when mode bit is 1. And, Kernel processes can only be executed when mode bit is 0.

Therefore, option B and C are correct.

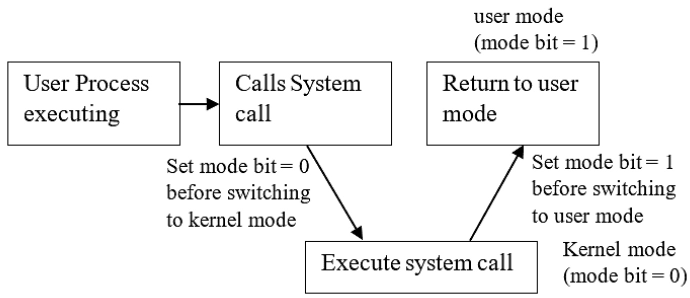
4. (a, b, c)

Mode shifting is required to switch from User mode to Kernel mode and from Kernel mode to User mode.

User mode (mode bit = 1) → Kernel mode (mode bit =0)

Kernel mode (mode bit =0) → User mode (mode bit =1).

Therefore, option A, B are correct.



An Interrupt is required to switch from user mode to kernel mode whereas a privileged instruction is required to switch from kernel mode to user mode. Therefore, option C is correct and option D is incorrect.

5. (b)

There is no ready state in Uni-programmed OS, single process is loaded from memory and directly executed on CPU.

6. (0)

The system is running in non-preemptive mode, so process A will continue its execution completely. While process A is executing, process B needs to wait in ready queue in the ready state (despite having higher priority).

(i) Process A will move from Ready to Running state- Process A is already running, so this transition is not possible in given scenario.

(ii) Process B will move from Ready to Running state- Since it is a non-pre-emptive system, process B have to wait till the time Process A finishes its execution.

(iii) Process A will be blocked till the time Process B is in running state- This is only possible if Process A needs I/O service, but it is not given. So this scenario is also not possible

(iv) Process A will move to Ready state from running state till the time process B is in running state. This scenario is possible in preemptive system, but it is given that the system is non-preemptive. So not possible.

(v) Process B will move from Block state to Running state. Process B is waiting in ready queue, so this transition is also not possible.

Hence, none of the given scenarios are possible.

7. (c)

Long term scheduler is also known as a **job scheduler**. This scheduler regulates the program and select process from the queue and loads them into memory for execution. It also regulates the degree of multi-programming. It is either absent or minimal in a time-sharing system. Long term Scheduler works between New and ready state.

Medium Term scheduler is an important part of **swapping.** It handles processes moving to and from blocked, suspended states.

Short Term Scheduler is also known as CPU scheduler and it plays major role in time shared operating system. As it works between Running state and ready state.

So, option C is the correct answer.

8. (25)

Process	Arrival Time	Burst Time	Completion Time	Waiting time
P1	10	4	16	2
P2	5	6	11	0
P3	6	1	12	5
P4	1	2	3	0

P4		P2	P3	P1

1 3 5 11 12 16

Total context switches = 6 = X

Total time CPU remain idle = 1 (unit between 0 and 1) + 2 (unit between 3 and 5) = 3 = Y

Total waiting time = 7

(X * Y) + Z = (6 * 3) + 7 = 25

9. (b)

Gantt Chart:

P1	P4	P3	P2

0 8 10 13 18

Process	Arrival Time	Burst Time	Completion Time	Turnaround Time	Waiting Time
P1	0	8	8	8	0
P2	4	5	18	14	9
P3	6	3	13	7	4
P4	8	2	10	2	0
				Average TT= 7.75	Average WT= 3.25

Difference between average turnaround time and average waiting time = 7.75- 3.25 = 4.5

10. (c)

2 ms

Gantt chart:

P1	P2	P1	P5	P3	P4

0 3 4 6 8 11 17

Process	Arrival Time	Burst Time	Completion Time	Turnaround Time	Waiting Time
P1	0	5 ms	6	6	1 ms
P2	3	1 ms	4	1	0 ms
P3	5	3 ms	11	6	3 ms
P4	7	6 ms	17	10	4 ms
P5	4	2 ms	8	4	2 ms

Average Waiting time = (1 + 3+ 4 + 2)/5 = 2

11. (b, d)

(a) SJF gives the optimal average turnaround time among all scheduling algorithms. Correct.

(b) FCFS may suffer from starvation. Incorrect, in FCFS there is no chance of starvation.

(c) SJF may suffer from starvation. Correct, SJF may suffer from starvation for processes with longer burst time.

(d) SRTF do not have starvation. Incorrect, SRTF may have starvation for processes with longer burst time.

12. (d)

The question is asking pre-emptive scheduling algorithm which suffers from convoy effect.

FCFS and SJF both are Non-preemptive in nature. So, A and B are incorrect.

SRTF is pre-emptive in nature but it does not suffer from convoy effect. So, C is also incorrect.

Although, FCFS suffers from convoy effect but it is non-preemptive in nature.

Therefore, option D is the correct answer.

13. (a, b)

Ready queue and Block queue are present on main memory. Device queue and Input/Job queue are present on disk.

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 02

Subject : Operating System

Topic : CPU Scheduling

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[NAT]

1. Consider the following set of processes, with the arrival times and the CPU-burst times given in milliseconds.

Process	Arrival Time	Burst Time
P1	0	5
P2	1	3
P3	2	3
P4	4	1

What is the average turnaround time for these processes with the shortest remaining processing time first algorithm? (Up to 1 decimal point).

[MCQ]

2. Which of the following scheduling algorithm is/are implementable?

(i) FCFS (ii) SJF
(iii) SRTF (iv) LRTF
(v) HRRN (vi) RR

(a) (i), (v) and (vi) (b) (ii), (iii) and (iv)
(c) (i), (vi) (d) None of these

[MCQ]

3. Consider the following set of processes:

Process	Arrival Time	Burst Time
P1	0	2
P2	1	3
P3	2	6
P4	3	4
P5	4	5

What is the average turnaround time and average waiting time when the processes are scheduled using First Come First Serve (FCFS) algorithm?

(a) TAT = 7.25 and WT = 6.25
(b) TAT = 6.8 and WT = 4.9
(c) TAT = 8.6 and WT = 4.6
(d) TAT = 5.25 and WT = 3.5

[NAT]

4. Consider the set of processes.

Process	Arrival time	Burst time	Priority
P1	0	2	4
P2	1	4	1
P3	2	8	2
P4	3	5	3

Assume that the above processes are scheduled using non-pre-emptive priority scheduling (Highest number have highest priority). What is the average turnaround time (in ms)? (Up to 2 decimal points)

[MCQ]

5. Consider the following table of arrival time and burst time (all in msec) for 4 processes P_1, P_2, P_3 and P_4

Process	Arrival time	Burst time
P1	1	8
P2	3	3
P3	0	6
P4	5	5

If the highest response ratio next CPU scheduling algorithm is used to schedule the processes, then which two processes has minimum turnaround time and minimum waiting time?

(a) P1 and P2 (b) P2 and P3
(c) P3 and P4 (d) P4 and P1

Q.6 to 10 Carry TWO Mark Each

[NAT]

6. A process is executed in 150 msec. It takes 8 msec for the CPU to decide which process to execute. Then how much percentage of CPU time is used for scheduling.

[MCQ]

7. Consider the set of following processes.

Process	Arrival time	Burst time
P1	1	2
P2	0	3
P3	5	6
P4	3	8

Assume that the processes are scheduled using the non-pre-emptive Longest Job First (LJF) algorithm. What are the average turnaround time and average waiting time?

(a) 8.5 and 4.5 (b) 10.2 and 5.5
(c) 3.6 and 1.2 (d) 7.5 and 3.5

[NAT]

8. Consider the following proposed CPU scheduling algorithm:

Step 1: START

Step 2: Make a ready queue of the Processes say REQUEST.

Step 3: Do steps 4 and 5 WHILE queue REQUEST becomes empty.

Step 4: Pick the first process from the ready queue and allocate the CPU to it for a time interval of 1 time quantum.

Step 5: After the time quantum expires, select the process with minimum burst time.

Step 6: END

Let the time quantum = 10 milliseconds

Using this scheduling algorithm, calculate average waiting time for the given following processes.

Process	Arrival Time	Burst Time
P1	0	6
P2	4	15
P3	12	25
P4	15	20
P5	19	36

[MCQ]

9. Consider a set of 5 processes with burst time 7, 8, 5, 6, 12, all arrive at time zero. What is the minimum achievable average waiting time for these processes in non-pre-emptive scheduler?

(a) 15.6 (b) 12.0
(c) 14.5 (d) 17.0

[MSQ]

10. In non-preemptive priority scheduling if priority of five processes are 3, 4, 2, 1(highest), 5 and burst time is 7, 8, 9, 12, 3 respectively. If all the processes arrived at time zero, then which of the following statements is/are incorrect.

(a) If priority of P4 and P5 is swapped then average waiting time will be reduced.

(b) P2 can never complete its execution before P3

(c) Total turnaround time will be 26

(d) If priority of P4 and P5 is swapped then average waiting time = average turnaround time.

Answer Key

1. (5.5)
2. (c)
3. (c)
4. (10.00)
5. (b)
6. (5)
7. (b)
8. (16.8)
9. (b)
10. (c, d)

Hints and Solutions

1. (5.5)

Gantt Chart:

P1	P2	P4	P3	P1

0 1 4 5 8 12

Turnaround time for

P1 = 12 – 0 = 12

P2 = 4 – 1 = 3

P3 = 8 – 2 = 6

P4 = 5 – 4 = 1

Average turnaround time = $\frac{(12+3+6+1)}{4}$ = 5.5

2. (c)

FCFS and RR are implementable because they do not need knowledge of burst time aprior of process execution. Whereas, SJF, SRTF, LRTF, HRRN all need to know process's burst time in advance, which is practically not possible.

3. (c)

Gantt Chart:

P1	P2	P3	P4	P5

0 2 5 11 15 20

Process	Arrival time	Burst time	Completion Time	Turnaround Time	Waiting Time
P1	0	2	2	2	0
P2	1	3	5	4	1
P3	2	6	11	9	3
P4	3	4	15	12	8
P5	4	5	20	16	11

Average Turnaround time = $\frac{(2+4+9+12+16)}{5}$

= 8.6

Average waiting time = $\frac{(0+1+3+8+11)}{5}$ = 4.6

4. (10.00)

Gantt Chart:

P1	P3	P4	P2

0 2 10 15 19

Process	Arrival time	Burst time	Priority	Completion Time	Turnaround Time
P1	0	2	4	2	2
P2	1	4	1	19	18
P3	2	8	2	10	8
P4	3	5	3	15	12

Average turnaround time = $\frac{(2+18+8+12)}{4}$ = 10.00

5. (b)

P3

0 6

At time 6, all the processes arrived, calculating response ratio

For P1 = (5 + 8)/ 8 = 1.625

For P2 = (3+3)/3 = 2

For P4 = (1 +5)/5 = 1.2

So, P2 will be scheduled next.

P3	P2	

0 6 9

Calculating response ratio for P1 and P4

For P1 = (8 + 8)/ 8 = 2

For P4 = (4 + 5)/5 = 1.8

So, P1 will be scheduled next, and P4 will be scheduled at last.

P3	P2	P1	P4

0 6 9 17 22

Process	Arrival time	Burst time	Completion Time	Turnaround Time	Waiting Time
P1	1	8	17	16	8
P2	3	3	9	6	3
P3	0	6	6	6	0
P4	5	5	22	17	12

So, process P2 and P3 has minimum turnaround time i.e., 6 and 6 respectively.

And, process P2 and P3 have minimum waiting time i.e., 3 and 0 respectively.

6. **(5)**

CPU takes 8 ms to decide which process to execute, and then execute that process for 150 ms.
How much % of CPU time is used for scheduling = efficient time for CPU scheduling
So, efficiency of CPU scheduling = Useful time/ total time
Useful time (i.e. time required for scheduling) =8 ms
Total time (i.e. total time required for a process including execution time also) = 150ms + 8ms
Efficiency = 8/(150 + 8) = 0.0505 = 5.05%
Percentage of CPU time is used for scheduling= 5% (approx.)

7. **(b)**

P2	P4	P3	P1

0 3 11 17 19

Process	Arrival time	Burst time	Completion Time	Turnaround Time	Waiting Time
P1	1	2	19	18	16
P2	0	3	3	3	0
P3	5	6	17	12	6
P4	3	8	11	8	0

Average turnaround time = $\frac{(18+3+12+8)}{4}$ =10.25

Average waiting time = $\frac{(16+0+6+0)}{4}$ = 5.5

8. **(16.8)**

P1	P2	P4	P3	P5

0 6 21 41 66 102

WT(P1) = 0
WT (P2) = 2
WT (P3) = 29
WT (P4) = 6
WT (P5) = 47
Average waiting time = 16.8

9. **(b)**

SJF (non-pre-emptive) algorithm is the most optimal algorithm and provide minimum average waiting time. So, to achieve minimum average waiting time, we will use SJF.

Process	Arrival time	Burst time
P1	0	7
P2	0	8
P3	0	5
P4	0	6
P5	0	12

P3	P4	P1	P2	P5

0 5 11 18 26 38

Waiting time = TAT – BT
WT(P1) = 11 WT (P2) = 18
WT (P3) = 0 WT (P4) = 5
WT (P5) = 26
Average Waiting time = 60/5 = 12

10. **(c, d)**

Process	Arrival time	Burst time	Priority
P1	0	7	3
P2	0	8	4
P3	0	9	2
P4	0	12	1 (highest)
P5	0	3	5

Gantt Chart:

P4	P3	P1	P2	P5

0 12 21 28 36 39

Average waiting time = 19.4
Average turnaround time = 27.2

If priority of P4 and P5 is swapped:

Process	Arrival time	Burst time	Priority
P1	0	7	3
P2	0	8	4
P3	0	9	2
P4	0	12	5
P5	0	3	1

Gantt Chart:

P5	P3	P1	P2	P1

0 3 12 19 27 39

Average waiting time = 12.2
Average turnaround time = 20

(a) If priority of P4 and P5 is swapped then average waiting time will be reduced. Correct.
(b) P2 can never complete its execution before P3. P2 has higher lower priority than P3, so Correct.
(c) Total turnaround time will be 27.2. Incorrect. Total turnaround time is 136, average turnaround time is 27.2.
(d) If priority of P4 and P5 is swapped then average waiting time = average turnaround time. Incorrect.
Option C and d are incorrect.

Branch : CSE & IT   Batch : Hinglish

WEEKLY TEST – 03

Subject : Operating System

Topic : Process Synchronization / Coordination

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[NAT]

1. At a particular time of computation, the value of a counting semaphore is 12. Then 12P operation and xV operations were performed on the semaphore. If the final value after all wait and signal operations is 8, then value of x is _______.

[MCQ]

2. Consider the following proposed solution to critical section problem for two process i and j. For process Pi j will be 1-i :

```
do{
    flag[i] = True;
    turn = j;
    while (flag[j] && turn = = j);
        <Critical Section>
    flag[i] = true;
    <remainder section>
  }
while(true);
```

The above solution satisfies

(a) Mutual Exclusion and Progress.

(b) Only Mutual Exclusion.

(c) Mutual Exclusion and Bounded Waiting.

(d) Mutual Exclusion, Progress and Bounded Waiting.

[MCQ]

3. Consider the definition of operation's performed on semaphore:

```
wait(S){              Signal(S){
  while(X);             Z;
  Y                   }
```

Which of the following represents correct value of X, Y and Z respectively?

(a) S < 0; S – –; S + +

(b) S ≥ 0; S + +; S – –

(c) S ≤ 0; S – –; S + +

(d) S > 0; S + +; S – –

[NAT]

4. Assume that 'A' is counting semaphore. Consider the following program segment:

```
A = 12;
P(A);
V(A);
P(A);
V(A);
V(A);
P(A);
P(A);
P(A);
P(A);
```

What is the value of 'A' at the end of the above program execution?

[MCQ]

5. Which of the following is the guaranteed solution of avoidance of mutual exclusion?

(a) Semaphore.

(b) Monitors.

(c) Banker's algorithm.

(d) All of these.

Q.6 to 10 Carry TWO Mark Each

Common Data for Question 6 and 7

```
Semaphore mutex = 1;
Semaphore empty = N;
Semaphore full = 0;
void producer (void)
{
    int itemp;
    while(true)
    {
     producer-item (itemp);
    down (empty);
    down (mutex);
    buffer[in] = itemp;
    in = (in + 1) mod N;
    up(mutex);
    up(full);
    }
}
void consumer (void)
{
    int itemc;
    while(true)
    {
    down (full);
    down (mutex);
    itemc = buffer[out];
    out = (out + 1)mod N;
    up(mutex);
    up(empty);
    process-item(itemc);
    }
}
```

[MCQ]

6. What happens if we interchange down (empty), down (mutex) in the producer code ___

(a) No problem, the solution still work correct.

(b) Both consumer and producer will access the buffer at same time.

(c) Some of the item produced by the producer will be lost.

(d) It is possible for deadlock.

[MCQ]

7. What happens if we interchange down (full), down (mutex) in the consumer code ___

(a) No problem, the solution still work correct.

(b) Both consumer and producer will access the buffer at same time.

(c) Some of the item produced by the producer will be lost.

(d) It is possible for deadlock.

[MCQ]

8. Consider two process P_1 and P_2 accessing the shared variable X = 10 and Y = 20 protected by two binary semaphore B_x and B_y respectively, both initialized to 1. P and V denote the usual semaphore operations

P_1	P_2
L_1: P(Bx)	L_3: P(B_X)
L_2: P(B_Y)	L_4: P(B_Y)
X = X + 1;	Y = Y + 1;
Y = Y – 1;	X = Y – 1;
V(B_X)	V(B_Y)
V(B_Y)	V(B_X)

What would be the maximum value of X and Y?

(a) X = 21 and Y = 20

(b) X = 20 and Y = 21

(c) X = 11 and Y = 11

(d) None of these

[MCQ]

9. Consider the following snippet for solution to critical section problem:

```
do{
    acquire lock
        critical section
    release lock
        remainder section
    }
    while(true);
```

Which of the following define acquire lock and release lock correctly?

(a) acquire () {   release () {

```
    while(! avail);         avail = true;
    avail = false;        }
  }
```

(b)
```
acquire () {              release () {
    avail = false;            avail = true;
}                          }
```

(c)
```
acquire () {              release () {
    avail = true;             while(!avail)
}                              avail = false;
                           }
```

(d) None of these

[MCQ]

10. Let P and Q be processes and let S and t be semaphores. Initially, both S and t are 1. The two processes execute the steps shown below. Show a sequence of steps that leads to deadlock

P:	Q:
Step P_1: Down (s)	Step Q_1: Down (s)
Step P_2: Down (t)	Step Q_2: Down (t)
Step P_3: CS – PA	Step Q_3: CS – QA
Step P_4: UP (s)	Step Q_4: UP(t)
Step P_5: Down (s)	Step Q_5: UP(s)
Step P_6: CS – PB	
Step P_7: UP(s)	
Step P_8: UP(t)	

(a) P_1, P_2, Q_1, Q_2

(b) P_1, P_2, P_3, P_4, Q_1, Q_2, P_5

(c) Q_1, Q_2, Q_3, P_1, P_2

(d) Q_1, Q_2, Q_3, Q_4, Q_5

Answer Key

1. (8)
2. (b)
3. (c)
4. (9)
5. (b)
6. (d)
7. (d)
8. (b)
9. (a)
10. (b)

Hints and Solutions

1. (8)

Initial value of semaphore = 12.

Total wait operation = 12P

Total signal operation = xV

Final Value = 8

So,

8 = 12 – 12P + xV

8 = 12 – 12 + xV

x = 8

2. (b)

The given code is modified Peterson's solution for critical section problem and it satisfies only mutual exclusion.

3. (c)

The definition of wait() and signal() operation performed on semaphore are as follows:

```
wait (S) {
      while(S < = 0);
      S – –;
}
signal (S) {
      S + +;
}
```

Therefore, option (c) is correct.

4. (9)

A = 12

P(A) = 11

V(A) = 12

P(A) = 11

V(A) = 12

V(A) = 13

P(A) = 12

P(A) = 11

P(A) = 10

P(A) = 9

So, the final value of 'A' is 9.

5. (b)

Monitors allows one process to execute in critical section at a time. It always satisfies the mutual exclusion properties.

Improper use of semaphore does not lead to avoidance of mutual exclusion.

Banker's algorithm is not related to mutual exclusion.

6. (d)

Producer	**Consumer**
down(mutex)	down(full)
down(empty)	down(mutex)
C.S	**C.S**
up(mutex)	up(mutex)
up(full)	up(empty)

Buffer full:

mutex = ~~1~~ 0 empty = ~~0~~ –1 ← producer suspended full = 8	mutex = 0 ← consumer suspended empty = –1 full = ~~8~~ 7
leads to deadlock	

7. (d)

The interchange will lead to deadlock.

8. (b)

I. $X = 10, Y = 20$

For the maximum value of X, run P_1 first

P_1: $X = X + 1$: $10 + 1 = 11$

Preempt P_1

P_2: $Y = Y + 1$: $20 + 1 = 21$

$X = 21 - 1 = 20$

$\therefore$ $X = 20$

Resume P_1

P_1: $Y = Y - 1$: $21 - 1 = 20$

II. For the maximum value of Y

P_2: Read Y value [i.e. 20]

Preempt P_2

P_1: $X = X + 1$: $10 + 1 = 11$

$Y = Y - 1$: $20 - 1 = 19$

Resume P_2

P_2: $Y + 1$: $20 + 1 = 21$

$Y = 21$

$\therefore$ $Y = 21$

$X = Y - 1$: $21 - 1 = 20$

Hence, the maximum value of X is 20 and Y is 21

9. (a)

The given code is solution to the critical section problem using mutex locks.

A mutex lock has a Boolean variable 'avail' whose value indicates if the lock is available or not. If the lock is available, a call to acquire() succeeds and the lock is then considered unavailable. A process that attempts to acquire an unavoidable lock is blocked until the lock is released.

The definition of acquire() and release is as follows:

```
acquire () {
    while(! avail);      /*busy wait*/
    avail = false;
}
release (){
avail = true;
}
```

10. (b)

The order of execution P_1, P_2, P_3, P_4, Q_1, Q_2, P_5 leads to deadlock.

Branch : CSE & IT **Batch:Hinglish**

WEEKLY TEST – 04

Subject : Operating System

Topic : Process Synchronization / Coordination

Maximum Marks 15

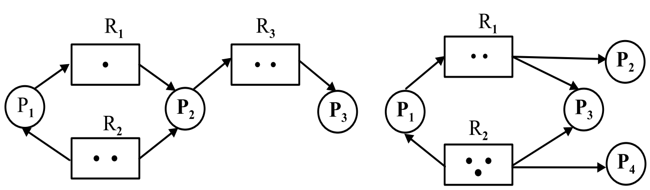
Q.1 to 5 Carry ONE Mark Each

[NAT]

1. Consider a system having 'n' resources of same type. All of these resources are shared by five process P0, P1, P2, P3 and P4 with a peak demand of 7, 8, 9, 10, and 11, respectively. What could be the maximum value of 'n' to ensure that the system is in deadlock.

[MCQ]

2. Consider the following resources allocation graph.



(i) (ii)

Which of the following is correct about above RAG?

(a) Both (i) and (ii) has Deadlock

(b) Only (i) has Deadlock

(c) Only (ii) has Deadlock

(d) None of (i) and (ii) has Deadlock.

[NAT]

3. Consider an operating system containing 'n' processes each requiring 5 resources. The maximum number of processes that can be executed without any deadlock if there are 20 resources is ______.

[NAT]

4. Consider three concurrent processes, P1, P2, and P3, as shown below, which access a shared variable X that has been initialized to 100.

P1	P2	P3
:	:	:
:	:	:
x = x + 20	x = x – 50	x = x + 10
:	:	:
:	:	:

Suppose the process are executed on a uniprocessor system running a time-shared operating system. If the minimum and maximum possible values of x after complete execution of x are A and B respectively, then the value of A + B is ___________.

[MCQ]

5. Consider the following code:

Process P_0 code:	Process P_1 code:
while(true)	while(true)
{	{
non-CS();	non-CS();
while(true!=0);	while(true!=1);
[CS]	[CS]
true = 1;	true = 0;
}	}

Initially CS value was true = 0. Which of the condition this code is not satisfying?

(a) Mutual Exclusion

(b) Progress

(c) Bounded waiting

(d) All of these.

Q.6 to 10 Carry TWO Mark Each

[MSQ]

6. Consider a system with 3 types of resources R_1, R_2 and R_3 in quantity 5, 7, 5 respectively. The allocation and max matrices are given as follows:

Allocation

	R_1	R_2	R_3
P_1	2	1	0
P_2	1	2	1
P_3	0	2	2
P_4	1	1	1

Max

R_1	R_2	R_3
2	3	3
2	3	2
3	2	3
3	3	2

Which of the following safe sequences are possible?

(a) P_4 P_2 P_1 P_3

(b) P_2 P_4 P_3 P_1

(c) P_2 P_1 P_4 P_3

(d) P_2 P_4 P_1 P_3

[MCQ]

7. Consider X, Y, Z are shared semaphore on following three concurrent processes:

Process-1	Process-2	Process-3
P(X)	P(Y)	P(Z)
P(Z)	Print “B”	P(X)
Print “A”	Print “E”	Print “C”
Print “D”	V(X)	Print “F”
V(Y)	V(Z)	

If these processes run concurrently and possible outputs are CFBEAD, ADCFBE, ACFDBE. What could be the initial value of X, Y and Z. So that above outputs are possible?

(a) X = 2, Y = 0, Z = 1

(b) X = 2, Y = 0, Z = 2

(c) X = 1, Y = 0, Z = 2

(d) X = 2, Y = 0, Z = 1

[MCQ]

8. Consider the following code:

```
main ()
int a = 0;
int b = 0;
begin
    Parbegin
  thread P();
  thread Q();
    Parend;
end;
```

```
thread P();                      threadQ();
  begin                            begin
   a = 1; /*statement 1*/            b = 4; /*statement 3*/
   b = b + a; /*statement2*/         a = a + 5; /*statement 4*/
  end;                             end;
```

Suppose a process has 2 concurrent threads; one thread executes statement 1 and 2 and other thread executes statement 3 and 4. What are the possible values of variable ‘a’ and ‘b’ when the code finishes execution?

(a) a = {1, 5, 6}
    b = {10, 4, 5}

(b) a = {1, 5, 6}
    b = {1, 4, 5}

(c) a = {1, 6}
    b = {10, 4, 5}

(d) a = {1, 6}
    b = {1, 4, 5}

[MCQ]

9. Consider program for P_1 and P_2:

```
P1()              P2()
{                 {
  P(m);             P(n)
  x++;              y++;
  P(n);             P(m);
  y++;              x++;
  V(n);             V(m);
  V(m);             V(n);
}                 }
```

If m and n are binary semaphore variable whose values are initially initialized to 1. x and y are shared resources whose values are initialized to 0.

Which of the following holds by above process?

(a) Deadlock, and No mutual exclusion

(b) No deadlock, and no race condition.

(c) Mutual exclusion and no deadlock.

(d) Deadlock, mutual exclusion.

[MCQ]

10. Consider the following code:

begin

S_1;

Parbegin

S_2;

S_3;

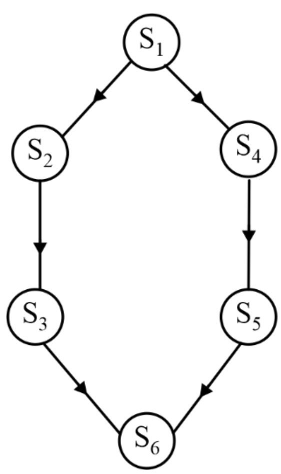
begin S_4; S_5; end

Parend;

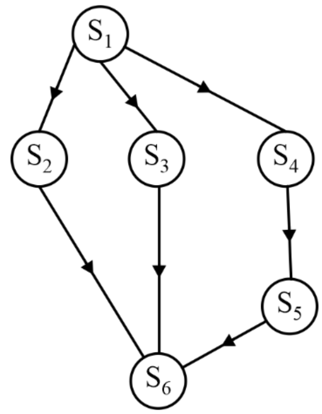
S_6;

Which of the following is correct precedence graph for the above code?

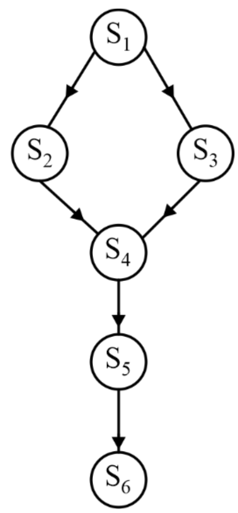
(a)



(b)



(c)



(d) None of these.

Answer Key

1. (40)
2. (d)
3. (4)
4. (180)
5. (b)
6. (b, d)
7. (b)
8. (c)
9. (d)
10. (b)

Hints and Solutions

1. (40)

The avoid the deadlock in a system, minimum resources required are:

$$\text{No. of resources} \geq \sum_{i=0}^{n} (\text{max} - \text{need}(i) - 1) + 1$$

To make the system go into deadlock, subtract one extra resource from each process.

$P_o \to 6$

$P_1 \to 7$

$P_2 \to 8$

$P_3 \to 9$

$P_4 \to 10$

In any process gets one resources, so the system will become deadlock free. So in order to ensure deadlock, there must be 6 + 7 + 8 + 9 + 10 = 40

Therefore, maximum value of n = 40.

2. (d)

There is no deadlock in both RAG.

In (i) Process will be executed in following order

$P_3 \to P_2 \to P_1$

In (ii) Process will be executed in following order

$P_2 \to P_4 \to P_3 \to P_1$

3. (4)

There is no deadlock in both RAG.

In (i) Process will be executed in following order

$P_3 \to P_2 \to P_1$

In (ii) Process will be executed in following order

$P_2 \to P_4 \to P_3 \to P_1$

4. (180)

Total possible execution sequences are

P_1, P_2, P_3

P_1, P_3, P_2

P_2, P_1, P_3

P_2, P_3, P_1

P_3, P_1, P_2

P_3, P_2, P_1

After executing processes in each of these sequences, we will get

A = 50 and B = 130

So, A + B = 180.

5. (b)

The above code behaving similar to strict alternation. Thus,

Mutual exclusion and bounded waiting are satisfied. Progress is not satisfied here as we are just focused on the true variable not on the interest of the process to enter the critical section or not.

6. (b, d)

From the given allocation and max matrices, need matrix can be computed as:

	R_1	R_2	R_3
P_1	0	2	3
P_2	1	1	1
P_3	3	0	1
P_4	2	2	1

Availability = 1, 1, 1

Only P_2's request can be fulfilled.

After P_2 is completed.

Available = 2, 3, 2.

Now, only P4 request can be fulfilled.

After P4 is completed.

Available = 3, 4, 3

Now, any of P_1 and P_3 can be serviced.

So, safe sequences are

$P_2\ P_4\ P_1\ P_3$ and $P_2\ P_4\ P_3\ P_1$

$\therefore$ option b, d are correct.

7. (b)

If we take X = 1, Y = 1, then after process – 1 or process – 3.

If both are concurrently running, then both of the processes will block and will stuck in deadlock situation.

If we take X = 2, Z = 1, Y = 0 or X = 1, Y =0, Z = 2 then only one of the output above mentioned will print.
An X = 2, Y = 0, Z = 2 if either process-1 or process-3 starts, it will set value to X=1, Y=0, Z=1 and if either process want to interrupt then it will set values to X-0, Y-0, Z-0 and then output will be printed.

8. (c)

for variable 'a':

I: a = 1
a = 1 + 5 = 6

II: a = 0 + 5 = 5
a = 1

Possible values of 'a' {1, 6}

for variable 'b':

I: b = 0 + 1
b = 4

II: b = 4
b = 4 + 1 = 5
b = 4

III: b = 4 + 6 = 10
Possible values of 'b' {4, 5, 10}

9. (d)

$P_1()$
1. P(m)
2. x ++

→ Preempted

$P_2()$
1. P(n)
2. Y++

P(m) //waiting for m to become 1

→ Preempted

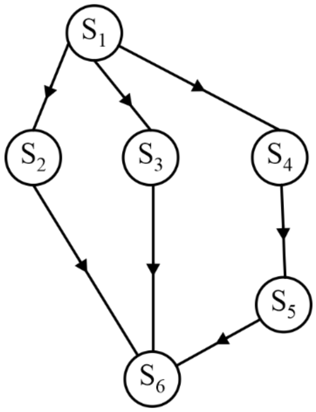
$P_1()$ //arrived again

3. P(n) //waiting for n to become 1

Thus, it creates deadlock.
There is mutual exclusion.
Therefore, option (d) is correct.

10. (b)

Precedence graph for given code is:



therefore, option (b) is correct.

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 05

Subject : Operating System

Topic : Memory Management

Maximum Marks 20

Q.1 to 6 Carry ONE Mark Each

[NAT]

1. Consider a memory address with 38 bits and each word is of 32 bits. The capacity of memory in terms of words is_______GW.

[MCQ]

2. Which of the following is not a address binding technique?

(a) Compile time address binding.

(b) Static time address binding.

(c) Dynamic time address binding.

(d) None of these

[MCQ]

3. Consider a system with 512 GW memory and each word is of 64 bits. The length of the address in terms of bits is_______bits.

[MCQ]

4. Consider the following statements:

S_1: Program to be loaded in main memory before run time is called static loading.

S_2: Program modules are loaded during run time on demand is called dynamic loading.

Which of the following is correct?

(a) S_1 only

(b) S_2 only

(c) Both S_1 and S_2

(d) Neither S_1 nor S_2

[MCQ]

5. Where does the swap space reside?

(a) RAM (b) Disk

(c) ROM (d) None of these

[MCQ]

6. Which of the following is an advantage of dynamic linking?

(a) It reduces execution time overhead.

(b) Faster execution.

(c) The segment that are not used in RAM no need to link them.

(d) None of these.

Q.7 to 13 Carry TWO Mark Each

[MSQ]

7. Which of the following is/are Incorrect?

(a) Static linking is performed before runtime.

(b) Dynamic linking is performed during compile time.

(c) Dynamic linking suffers from space inefficiency problem.

(d) In static linking there is no installer error.

[NAT]

8. The capacity of a memory is defined by the number of words multiplied by the numbers of bits/word. For memory of 4K × 16 if P are separate address lines and Q are separate data lines. Then the value of P * Q is ____.

[NAT]

9. On a system with 2^{37} bytes of memory and fixed partitions with a partition size of 2^{26} bytes, what is the minimum number of bytes needed in an entry in the process table to record the partition to which a process has been allocated?

[NAT]

10. Consider a system having memory of size 2^{48} bytes uses fixed partitioning. It is divided into fixed size 2^{29} bytes. The OS maintains a process table with one entry per process. Each entry has two fields. First is a pointer pointing to partition in which the process is loaded and second field is process ID. The size of process ID is 4 bytes, then calculate the size of pointer to the nearest byte.________.

[MCQ]

11. Which of the following bit does not belong to page number?

(a) Time of loading (b) Frame number

(c) Protection bit (d) None of these

[MSQ]

12. Which of the following is/are solution of external fragmentation?

(a) Compaction

(b) Non-contiguous memory allocation

(c) Fixed size partition

(d) None

[MCQ]

13. Consider a memory system having 6 partitions of sizes 200 KB; 400 KB; 600 KB; 500 KB; 300 KB; 250 KB

There are 4 processes of size: 357 KB; 210 KB; 468 KB; 49 KB using best fit allocation policy, what partitions are not allocated/remains unallocated?

(a) 300 KB and 600 KB

(b) 400 KB and 600 KB

(c) 500 KB and 600 KB

(d) None of these

Answer Key

1. (256)
2. (d)
3. (45)
4. (c)
5. (b)
6. (c)
7. (b, c)
8. (192)
9. (2)
10. (3)
11. (d)
12. (a, b)
13. (a)

Hints and Solutions

1. (256)

Number of address bits = 38

Number of words = 2^{38}

$= 256$ GW

So, capacity of memory is 256 GW.

2. (d)

There are only three binding times

- Compile time
- Load time
- Runtime

3. (45)

Capacity of memory = 512 GW

$= 2^9 * 2^{30}$ words

$= 2^9 * 2^{30} * 64$ bits

$= 2^{9+30+6}$ bits

$= 2^{45}$ bits

Length of the address = $\log_2 2^{45}$

$= 45$ bits

Hence, (45) is correct.

4. (c)

Both the statements are correct.

S_1: Program to be loaded in main memory before run time is called static loading.

S_2: Program modules are loaded during run time on demand is called dynamic loading.

5. (b)

Swapping is carried out from memory to disk.

6. (c)

The segments that are not used in a run need not be linked into the process address space.

7. (b, c)

- Static linking is performed before runtime i.e during compile time or load time.
- Dynamic linking is performed during runtime.
- Static linking may lead to space inefficiency because some modules that are not needed during runtime. We are linking them.
- Static linking just copy and run. No installer requires. So, No installer error.

8. (192)

Word size = 16 bit

Total words = 4K

$= 2^{12}$

So, 12 address lines needed

P = 12

Data base size in same as word length which is 16

Q = 16

P * Q = 12 * 16

= 192

Hence, (192) is correct.

9. (2)

Number of partitions = $\dfrac{2^{37}}{2^{26}}$

$= 2^{11}$

Therefore, to address each partition we need 11 bits means 2 bytes.

Hence, (2) is correct.

10. (3)

Ptr	PID

Number of partitions $= \dfrac{2^{48}}{2^{29}}$

$= 2^{19}$

Size of pointer = 19 bits

$\cong$ 3 bytes (size can never be less than 19 bits)

11. (d)

Frame	V/I	TOL	TOR	P_r	COR
↓	↓	↓	↓	↓	↓
Frame number	Valid Invalid bit	Time of loading	Time of reference	Protection	Count of reference

Hence, option (d) is correct.

12. (a, b)

Solutions of external fragmentation are-

(i) Completion

(ii) Non-contiguous memory allocation

13. (a)

200 KB	→ 49 KB
400 KB	→ 357 KB
600 KB	
500 KB	→ 468 KB
300 KB	
250 KB	→ 210 KB

So, 600 KB and 300 KB remains unallocated.

Branch : CSE & IT | Batch : Hinglish

WEEKLY TEST – 06

Subject : Operating System

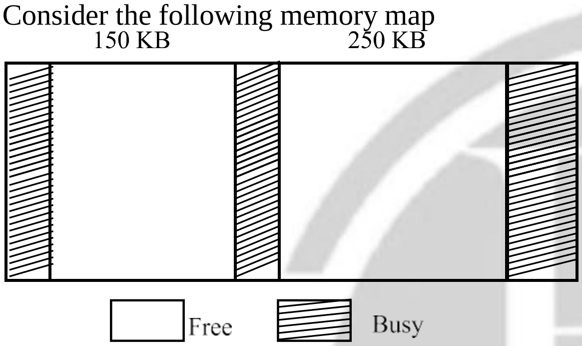
Topic : Memory Management

Maximum Marks 19

Q.1 to 5 Carry ONE Mark Each

[MSQ]

1. Consider the following memory map



The successive request of the processes are 50 KB, 200 KB, 50 KB and 100 KB.
Which of the following variable partitioning scheme satisfies the given process request?

(a) Best fit
(b) Worst fit
(c) first fit
(d) Next fit

[MSQ]

2. Assume, a system is suffering from thrashing which of the following factor(s) will help in recovery the system from thrashing?

(a) Install faster CPU
(b) Decrease the degree of multiprogramming
(c) Install more main memory
(d) Install more disk space

[NAT]

3. Consider an inverted paging architecture that supports logical address and physical address of sizes 30 bits and 24 bits respectively. The system is characterized with 8KB page size. If the memory is byte addressable, the difference in the conventional and inverted page table size is_________(in kilobits)
(Page table entry size in the conventional and inverted page table is 4 bytes.)

[NAT]

4. Consider a segmented paging architecture which supports 8GB logical and physical address spaces. The segment number requires 19 bits to represent all the segments in the logical address space. The maximum size of a page of the segment such that the page table of the segment fits into a memory frame is ________(in bytes)
(Assume the page table entry size of the segmented page table is 4 bytes)

[MCQ]

5. Consider the following statements:

S_1: Paging is a continuous memory management scheme.

S_2: In fixed partition scheme, all the partitions are of same size.

Which of the given statement(s) is/are CORRECT?

(a) S1 only
(b) S_2 only
(c) Both S_1 and S_2
(d) Neither S_1 nor S_2

Q.6 to 12 Carry TWO Mark Each

[MSQ]

6. Consider a demand paging architecture that is characterized with page fault rate 'P' and page fault service time is given as $3t^2 - 2t + 24$. The optimal value of the page hit rate such that the effective main memory access time is minimized is-

(Assume, the time required to access a frame in main memory is t)

(a) $\frac{1}{3-6t}$ (b) $\frac{1}{6(1-t)}$

(c) $\frac{5-t6}{6-t}$ (d) $\frac{2-6t}{3(1-2t)}$

[MCQ]

7. Consider the virtual page reference string
2021, 2022, 2023, 2024, 2022, 2021, 2025, 2023, 2022, 2024, 2026
Assume there are three-page frames which are initially empty. Let LRU, FIFO and Optimal denote the number of page faults under the corresponding page replacement policy. Which of the following statement(s) is/are CORRECT?

(a) Optimal<LRU<FIFO

(b) Optimal<LRU=FIFO

(c) Optimal = LRU

(d) Optimal = FIFO

[MCQ]

8. Consider a multi-level paging architecture having logical address of 48 bits and physical address of 32 bits. The operating system uses 3-level paging for logical to physical address translation. Assume, memory is byte addressable and page table entry size is 128 bits. What should be the optimal page size such that the first level page table fits in a memory frame?

(a) 4 KB (b) 16 KB

(c) 32 KB (d) 8 KB

[NAT]

9. consider a system with paging hardware in which a regular memory access takes 200 nanosecond and servicing a page fault takes 10 MS.
The TLB hit ratio is 80% and the page fault rate is one in every 5000 instructions. The effective average instruction execution time is___________nanosecond. (Assume TLB access time is 50 ns.) (Upto 3 decimal places)

[MSQ]

10. Let a memory have four free blocks-

P = 4K, Q = 8K, R = 10K, S = 2K

These blocks are allocated using best-fit strategy. The allocation request of the processes are given as-

Arrival time	Requesting Process	Requested size	Usage Time
0	A	2K	3
1	B	9K	6
2	C	2K	3
3	D	4K	2
4	E	4K	4
5	F	9K	3

Which of the following statements is/are CORRECT?

(a) At t = 10, all the process finish execution

(b) The process F has to wait for 3 units of time

(c) The process C, D and E are allocated Block P.

(d) D is allocated block Q.

[MCQ]

11. Consider a system using with TLB.
What is hit ratio is required to reduce the effective memory access time from 'E' ns to 'P' ns using TLB? (Assume that TLB access time is 'T' ns).

(a) $\frac{2P + 2PT + 2E}{E}$ (b) $\frac{(P + T + E)\,2}{(2T + E)}$

(c) $\frac{2\,[T + E - P]}{E}$ (d) None of these

[MCQ]

12. Consider a logical address of 32 Bit and page size of 8 KB. The page table is in hardware with one 32 Bit word per entry.
When a process starts the page table is copied to hardware from memory at one word every 100 ns. If each process rans for 100msec. (including the time to load the page table). What fraction of CPU time is devoted to loading the page tables?

(a) 20% (b) 52%

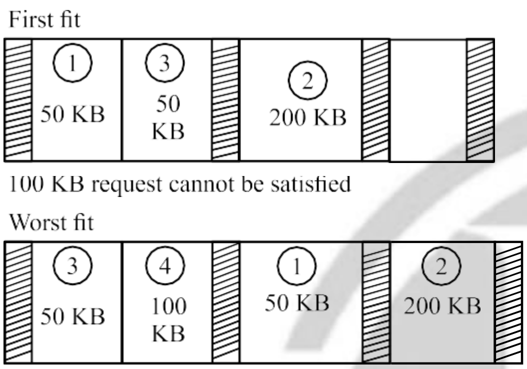
(c) 30% (d) None of these

Answer Key

1. (a, b)
2. (b, c)
3. (4032)
4. (256)
5. (d)
6. (d)
7. (b)
8. (c)
9. (253.992)
10. (a, d)
11. (c)
12. (b)

Hints and Solutions

1. (a, b)



Next fit works after last allocation point.

(50KB, 200KB, 50KB) can be serviced but 100 KB can't be.

2. (b, c)

The system can recover from thrashing by-

- decreasing the degree of multiprogramming
- Installing more main memory /allocating more frames to process undergoing thrashing.

3. (4032)

Conventical page table size = $\frac{2^{30}}{2^{13}} \times 2^2$ B

$= 2^{19}$ B $= 2^9$ KB

$= 2^{12}$ K bits

Inverted page table size $= \frac{2^{24}}{2^{13}} \times 2^2$ B

$= 2^{13}$ B $= 2^3$ KB

$= 2^6$ K bits

Difference in K Bits $= 2^{12} - 2^6$

$= 4032$

4. (256)

Logical address $= \log_2 = 8$ G

Segment size $= (33 - 19)$ bits

$= 14$ bits

Let the page size of the segmented page table be $2x$.

Page table size $= \frac{2^{14}}{2^x} \times 4$ bytes

$= 2^{16-x}$ bytes

Segmented page table size = frame size

$2^{16-x} = 2^x$

$16 - x = x$

$2x = 16$

$x = 8$

$\therefore$ Page size of the segment $= 2^8 = 256$ Bytes

5. (d)

S_1: INCORRECT. Paging is non-contiguous memory management scheme.

S_2: INCORRECT. In fixed partitioning, the number of the partitions are fixed. Partitions may vary in size.

6. (d)

Effective Main memory = P × S + (1 – P) × M

Access time (EMAT)

P: Page fault rate

S: Page fault server time

M: Main memory access time

$EMAT = P \times (3t^2 - 2t + 24) + (1 - P) \times t$

$\frac{d}{dt}(EMAT) = \frac{d}{dt}[P \times (3t^2 - 2t + 24) + (1 - P) \times t]$

$\frac{d}{dt}(EMAT) = P \times (6t - 2) + (1 - P)$

For minimizing EMAT-

$P \times (6t - 2) + (1 - P) = 0$

$P \times (6t - 2 - 1) + 1 = 0$

$P \times (6t - 3) = -1$

$P = \frac{1}{3 - 6t}$

Page hit rate $= 1 - P = 1 - \frac{1}{3-6t} = \frac{3-6t-1}{3-6t} = \frac{2-6t}{3-6t}$

7. (b)

LRU

2024	2022	2021	2025	2023	2022	2024	2026	
~~2021~~	2024	2024	~~2024~~	2025	2025	~~2025~~	2024	2024
2022	2022	2022	2022	~~2022~~	2022	2023	~~2023~~	2026
2023	2023	~~2023~~	2021	2021	~~2021~~	2021	2022	2022

Number of page faults = 3 + 7 = 10

FIFO

~~2021~~	2024	2024	2024	~~2024~~	2023	2023	~~2023~~	2026
2022	2022	~~2022~~	2021	2021	~~2021~~	2022	2022	2022
2023	2023	2023	~~2023~~	2025	2025	~~2025~~	2024	2024

Number of page faults = 3 + 7 = 10

Optimal –

2021	~~2021~~	~~2025~~	2023
2022	2022	20[illegible]	
~~2023~~	[illegible]		

Number of page faults = 3 + 4 = 7

8. (c)

Let page size be 'x' by xs

First time paging –

Page table size $= \frac{2^{48}}{x} \times 16$ B

$= \frac{2^{52}}{x}$ B

2nd Time paging–

Page table size $= \frac{2^{52}}{x} \times 16$ B

$= \frac{2^{56}}{x^2}$ B

3rd time paging–

Page table size $= \frac{2^{56}}{x} \times 16$ B

$= \frac{2^{60}}{x^3}$ B

$\Rightarrow \frac{2^{60}}{x^3} = x$

$= 2^{60}$ B $= x^4$

$= x = 2^{15}$ bytes = 32 KB

9. (253.992)

EMAT $\Rightarrow$ x (C + M) + (1– x) [P × S+ (1 – P) × M + C]

Where X = TLB = hit rate

C = TLB access time

M = Main memory access time

P = Page fault rate

S = Page fault service time

$\Rightarrow$ EMAT $= 0.8\,(50 + 200) + 0.2\left[\frac{1}{5000} \times 10{,}000 + \frac{4999}{5000} \times 200 + 50\right]$

$\Rightarrow$ 253.992 nanoseconds

10. (a, d)

0 1 2 3 4 5 6 7 8 9 10

4K			C	C	C	E	E	E	E	
8K				D	D					
10K		B	B	B	B	B	B	F	F	F
2K	A	A	A							

(F has to wait till t = 7)

E has to wait for 1 unit as its request size is 4k

11. (c)

Without TLB:

EMAT = 2 × M

E = 2M

$M = \frac{E}{2}$

With TLB:

EMAT = x (C + M) + (1 – x) (C + 2M)

$P = x\left(T + \frac{E}{2}\right) + (1-x)\left(T + 2 \times \frac{E}{2}\right)$

$P = x\left(T + \frac{E}{2}\right) + (1-x)\,(T + E)$

$P = x\left(T + \frac{E}{2}\right) + T + E - Tx - Ex$

$P - T - E = x\left(T + \frac{E}{2}\right) - x\,(T + E)$

$P - T - E = x\left(T + \frac{E}{2} - T - E\right)$

$P - T - E = x\left(-\frac{E}{2}\right)$

$x = \frac{2\,(T + E - P)}{E}$

12. (b)

Logical address = 32 bits

Page size = 8 kb

Number of Entries in page table = $\frac{2^{32}}{2^{13}}$

= 219 entries

= 512 k entries

- For 1 word copied from memory to hardware = 100 ns
- For 1 entry time to copied from memory to hardware = 100 ns
- Total CPU time to load the entries = 100 × 512 k ns

Total time = 100ms

$= \frac{\text{\% CPU time}}{\text{loading of page table}}$

$= \frac{512\, k \times 100\, ns}{100 \text{ ms}}$

$= \frac{512 \times 1024 \times 10^{-9} \times 10^{3}}{100}$

$= \frac{512 \times 1024}{100} \times 10^{-6}$

$= 512 \times 1024 \times 10^{-6}$

$= 524288 \times 10^{-6}$

$= .5242 \times 100$

$\cong 52\%$

Hence, option (b) is correct.

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 07

Subject : Operating System

Topic : File System and Device Management

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. Suppose an index-based file system with the i-node comprises 32 indexes, 1 indirect index pointing to disk block containing an array of direct indexes, and 1 2-level index in the usual way. Assume that each index takes 2 bytes and the disk block is 512 bytes, then the number of disk accesses it takes to read the 8000th byte of the file (assuming no caching is done) is .

(a) 1 (b) 2

(c) 3 (d) 4

[MCQ]

2. A Unix inode stores______.

(a) Only the name of a file.

(b) Only file allocation information about a file.

(c) Only access permission information about a file.

(d) Access permissions and file allocation information for a file, as well as some other information.

[NAT]

3. How many times does the following program prints the "GateWallah"?_________

```
#include <stdio.h>
#include <unistd.h>
int main ()
{
    int a;
    for (a = 0; a < 3; a++)
    fork ();
    printf ("GateWallah\n");
    return 0;
}
```

[MCQ]

4. What is the advantage of using multiple threads over multiple processes in an application?

(a) Improved security

(b) Increased memory usage

(c) Improved performance and responsiveness

(d) Reduced need for synchronization.

[MCQ]

5. What is thread-local storage, and how it is used in multi-threaded program?

(a) Thread-local storage is a mechanism for allocating thread libraries to threads in a process.

(b) Thread-local storage is a mechanism for allocating storage for thread-specific data.

(c) Thread-local storage is a mechanism for sharing data between threads in a process.

(d) Thread-local storage is a mechanism for synchronizing access to shared resources.

Q.6 to 10 Carry TWO Mark Each

[NAT]

6. Assume a magnetic disk containing 800 sectors per track, an application needs to read 200 randomly scattered sectors for loading the libraries at startup. Reading of each sectors requires exactly one disk access. The average seek time of the disk to a random location is given as 20 ms. Rotational speed of the disk is 12000 rpm, then the time taken to load libraries at startup to run the application is________ms.

[NAT]

7. Disk requests come into the disk driver for cylinders, 20, 32, 30, 12, 50, 16 and 48, in that order. A seek takes 6 msec per cylinder. The total number of cylinders are 51. If the arm is initially at cylinder 30. The seek time that is needed for elevetor algorithm (initially moving upward) is________msec.

[MCQ]

8. A UNIX file system has 1KB block size and 4- byte disk address. What is the maximum file size, if the inode contains 8 direct block entries, one single indirect block entry, one double indirect block entry and one triple indirect block entry?

(a) 10 GB (b) 16 GB

(c) 30 GB (d) 50 GB

[MSQ]

9. Which of the following statements is/are true?

(a) The file allocation table uses much less disk space than the linked structure.

(b) The simple linked structure uses much less disk space than the file allocation table method.

(c) The file allocation table method allows faster seeks in files.

(d) The simple linked allocation method allows faster seeks in files.

[NAT]

10. Consider only FCB of file in memory, block pointer requires 16 bits and that blocks holds 2048 bytes each, then the number of disk accesses are needed to bring byte j of the file into memory when the file is stored using contiguous allocation is________?

Answer Key

1. (b)
2. (d)
3. (8)
4. (c)
5. (b)
6. (4501.25)
7. (540 msec)
8. (b)
9. (c)
10. (1)

Hints and Solutions

1. (b)

The disk block that will have the 8000th byte of the file = $\frac{8000}{512}$ = 15.625

Data blocks i.e . . . 15 data blocks are full and the 16th data block is holding the 8000th byte of the file, which means we have to read the i-node into the memory (no caching) for the direct block address which ranges from (0 – 31) and corresponding direct data block. Hence 2 reads are required, therefore option (b) is correct.

2. (d)

A Unix inode stores access permissions and file allocation information for a file, as well as some other information.

3. (8)

Main

|

$2^3 – 1$

Total 7 + 1 = 8 because main will also print GateWallah.

4. (c)

As threads are light weight processes, it improves performance and responsiveness as compared to multiple process.

5. (b)

Thread local storage is a mechanism for storing data that is private to each thread. Thread Local Storage (TLS) is the mechanism by which each thread in a given multithreaded process allocates storage for thread-specific data. In standard multithreaded programs, data is shared among all threads of a given process, whereas thread local storage is the mechanism for allocating per-thread data.

6. (4501.25**)**

Given 12000 Rpm

12000 rotations in a minute → 60 seconds

12000 rotations in an half minute = $\frac{60}{12000 * 2}$

= 2.5 ms (which is the average rotational delay)

Now, we have 800 sectors per track

12000 * 800 sectors in 60 seconds

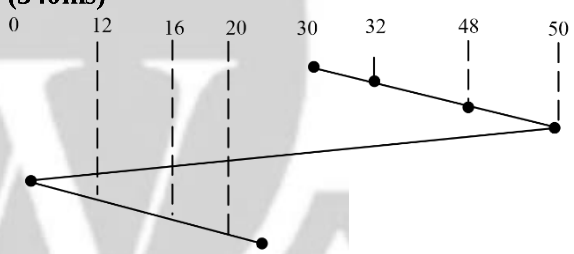
1 sector = $\frac{60}{12000 * 800}$ = 0.00625ms

Total time to access a random sector = average seek time + average rotational delay + time to read from 1 sector

= 20 + 2.5 + 0.00625 = 22.50625ms

We have to read 200 randomly located sector so total time = 200 * 22.50625 = 4501.25ms

7. (540ms)



(50 – 30) + (50 – 0) + (20 – 0)

20 + 50 + 20 = 90

90 * 6 msec

540 msec.

8. (b)

Direct block entry points 1KB.

So, 8 direct block entries can point 1 × 8 = 8 KB

Single indirect block:

We have 4 byte address

So, number of blocks in indirect block = 1 KB/4 = 256 blocks.

One indirect block entry can point 256 × 1 KB = 256 KB

Double indirect block:

Similarly, 256 × 256 × 1 KB = 64 MB

Triple indirect block:

256 × 256 × 1KB = 16 GB

Total file size = 16 GB + 64 MB + 256 KB + 8 KB ≈ 16GB

9. (c)

The advantage of FAT over simple linked file structure is that, the FAT method allows faster seeks in files.

10. (1)

Since that allocation used is a contiguous method, all the blocks are stored contiguously. Therefore, a particular byte is accessed in 1 disk access.

Ranker Test (as per GATE Pattern)

Subjects : (1) C-Programming
(2) Digital Logic
(3) Theory of Computation
(4) Discrete Mathematics

[NAT 1 Mark]

1. Consider the following program:

```
#include<stdio.h>
int r()
  {
    static int i;
    return i++;
  }
int main()
  {
    int i=0, j=1;
    for(i++; i++<9; i++)
    {
        switch(r() + i)
          {
          case 1: j+= 2;
          break;
          default: j+= 3;
          case 2: j+= 1;
          break;
          }
    }
  }
```

The final value of i + j is ________.

[MCQ 1 Mark]

2. Consider the following two languages L_1 and L_2:

$L_1 = \{0^m 1^n \mid m, n \geq 0\}$

$L_2 = \{0^m 1^m \mid m \geq 0\}$

If $L = \left(L_1 \cap \overline{L_2}\right)$ then the language L will be

(a) $L = \{0^m 1^m \mid m \geq 0\}$

(b) $L = \{0^m 1^n \mid m! = n\}$

(c) $L = \{X - 0^m 1^n \mid X = \{0 + 1\}^*, m! = n\}$

(d) None of these.

[NAT 1 Mark]

3. Function $f = \overline{A}BD + \overline{A}CD + \overline{A}C\overline{D} + AB\overline{C}D + ABCD$ minimum number of NAND gates required to implement the function?

[NAT 1 Mark]

4. Consider a language $L = \{w \mid w \in \{a, b\}^*$, 8^{th} symbol from end is 'a'$\}$

If number of states in NFA are A and number of states in DFA are B then the value of A + B is ____.

[NAT 1 Mark]

5. Let $G = (V, E)$ be an undirected connected loop-free graph. suppose further that G is planar and determines 53 regions. If, for some planar embedding of G, each region has at least five edges in its boundary, then minimum number of vertices it can have _______.

[MCQ 1 Mark]

6. Consider the following program:

```
#include <stdio.h>
void func(char **p)
{
  printf("%s", *(p+3));
  printf("%s", *p++);
  printf("%s", *(p+++2));
  printf("%c", **p);
}
void main(){
char *a[ ]={"Parakram","2024","Shreshth","2025"};
func(a);
}
```

The output is___.

(a) 20252024reshthS

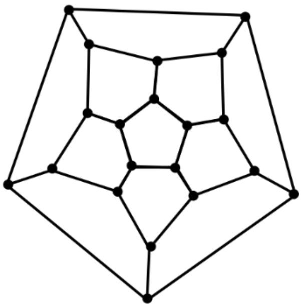
(b) 2025Parakram2025S

(c) 2025arakram2024S

(d) Compilation Error

[MSQ 1Mark]

7. Consider the following graph, and choose the correct statements.



(a) The given graph is Hamiltonian circuit.
(b) The chromatic number X(G) of the graph is 3.
(c) The given graph is an Eulerian.
(d) All the above statements are false.

[MSQ 1 Mark]

8. Which of the following statements is/are correct?

(a) The number 11101.11 on base 2 is equivalent to 1 D.3 on base 16.
(b) The number 1001.1 on base 2 is equivalent to 11.4 on base 8
(c) The number 112 on base 4 is equivalent to 211 on base 3
(d) The number 214 on base 5 is equivalent to 3 B on base 16.

[MCQ 1 Mark]

9. Which of the following is Turing acceptable language?

(a) Set of real numbers.
(b) Set of real numbers between 0 and 12.
(c) Set of prime numbers.
(d) All of the above.

[MCQ 1Mark]

10. A logical function $f(A, B, C) = \bar{A}B+\bar{B}C$.

Then the logical function $f_1(A,B,C)=f(f,\bar{f},A)$

Then $f_1(A,B,C)$ will be ?

(a) $AB+\bar{B}\bar{C}$ (b) $AB + BC$
(c) $A\bar{B}+B\bar{C}$ (d) $(A+\bar{B})(A+\bar{C})$

[MSQ 2 Marks]

11. Consider the following degree sequence:

5, p, 4, 4, 3, q, 2, 1 provided the sequence is graphical and the number of edges for the graph is 13, then find the possible values of p and q.

(a) 5, 2 (b) 7, 0
(c) 4, 3 (d) 6, 1

[MCQ 2 Marks]

12. Which of the following is undecidable?

(a) L = {< T > | T is Turing machine and it halts on some| string | $\leq$ 200}.
(b) L = {< G > | G is CFG and L(G) $\neq \phi$}.
(c) L = {< L_1, L_2> | L_1 and L_2 are DCFL and $L_1 = L_2$}.
(d) None of these.

[NAT 2 Marks]

13.
```
#include <stdio.h>
void fun2(int n);
void fun1(int n)
{
  if(n < 2) return;
  fun2(n – 2);
  printf("%d\t", n – 2);
}
void fun2(int n)
{
  if(n < 1) return;
  printf("%d\t", n – 1);
  fun1(n – 1);
}
int main()
{
  fun1(5);
  fun2(5);
  return 0;
}
```
The sum of the printed values is ____________.

[NAT 2 Marks]

14. The initial state of mod-16 down counter is 0110. After 68 clock pulses, the state of the counter will be equivalent to decimal number?

[MCQ 2 Marks]

15. Consider the following grammars G_1, G_2 and G_3:

G_1 : $S \to P\,Q$
$P \to 0\,P\,1 | \in$
$Q \to 1\,Q\,2 | \in$

G_2 : $S \to 0\,S1 | Q$
$P \to 1Q\,2 | \in$

G_3 : $S \to P\,Q | Q$
$P \to 0\,P\,1 | 01$
$Q \to 1\,Q\,2 | \in$

Here, {S,P,Q} are variables where S is start symbol. {0,1,2} are terminals.

Which of the following is true?
(a) G_1 and G_2 are equivalent.
(b) G_1 and G_3 are equivalent.
(c) G_2 and G_3 are equivalent.
(d) None of these.

[MCQ 2 Marks]

16.
```
#include <stdio.h>
void fun1 (int n);
void fun2(int n);
void fun1(int n)
{
      if (n < 2) return;
      fun2(n – 2);
      printf("%d \t", n – 2);
}
void fun2 (int n)
{
      if (n < 1) return;
      printf("%d\t", n – 1);
      fun1(n – 1);
}
int main()
{
   fun1(5);
   fun2(5);
   return 0;
}
```
The sum of the printed values is ___________.

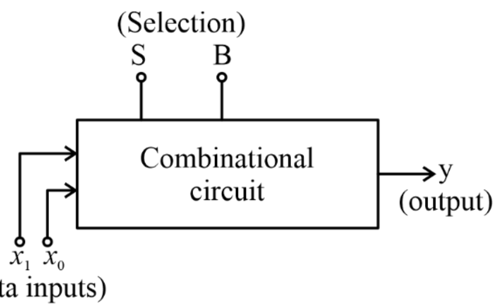
[MCQ 2 Marks]

17. The design of a combinational circuit is attempted as demonstrated below.

(i) For S = 0, y = 0 regardless of status of B

(ii) For S = 1 and B = 0, y = x_1

(iii) For S = 1 and B = 1, y = x_0



The minimum number count of 3-input NAND gates required to complete the design, will be?

(a) 3
(b) 2
(c) 4
(d) 1

[MCQ 2 Marks]

18. The output of the following C program is_____.
```
#include <stdio.h>
int main()
{
      void *p;
      char *c="GATEWallah";
      int a = 513;
      p = &a;
      printf("%d ", *(char*)p);
      p = c;
      printf((char*)p + 4);
      return 0;
}
```
(a) Garbage value
(b) 256Wallah
(c) 1Wallah
(d) 513EEWallah

[MSQ 2 Marks]

19. Consider the following languages:
L_1 = Context Free Language.
L_2 = Deterministic Context Free Language.
L_3 = Recursive Enumerable Language.
Which of the following is/are incorrect?
(a) $L_1 \oplus L_2$ is Context Free language but not Deterministic Context Free language.
(b) $L_1 \cup \overline{L_3}$ Recursive.
(c) $L_2 \cup \overline{L_3}$ is Recursive Enumerable.
(d) $\left(\overline{L_1} \cup \overline{L_2} \cup L_3\right)$ is Recursive Enumerable.

[MCQ 2 Marks]

20. Consider the following program:
```
#include<stdio.h>

int func(int i)

{

 i –= 3;

 return i;

}

void main(){

 int i = printf ("Parakram 2024");

 i = func (i = func (i = func(– –i)));

 printf("%d", i);

}
```
The output is-

(a) Parakram 20243
(b) Parakram 20246
(c) Parakram 20249
(d) Parakram 2024

[NAT 2 Marks]

21. How many don't care inputs are there in a BCD adder?

[MSQ 2 Marks]

22. Consider the following regular expressions P, Q and R over $\sum = \{a, b\}$:

P = ab + aQ + bR

Q = baQ + bR

R = Raba + a

Which of the following regular expression will produce all the strings accepted by above regular expression?

(a) $ab + ba(aba)^* [\in + a(ba)^*]$

(b) $ab + [\in + a(ba)^*] ba(aba)^*$

(c) $ab + a(ba)^+ ba(aba)^*$

(d) $ab + a(ba)^+ (aba)^* + ba(aba)^*$

[MCQ 2 Marks]

23. G be a connected graph in which only one node has degree > '1' and rest of the nodes are of degree 1. Add an edge between every two nodes of degree 1 in such a way that if a, b, c, d are node then a to b one edge, b to c one edge & d to a one edge. The resultant graph is sure to be

(a) Regular (b) Complete
(c) Hamiltonian (d) Euler

[NAT 2 Marks]

24. Consider the following program:

```
#include <stdio.h>
void func()          {
 int x = -5;
 static int y;
     do
     {
          x++;
          y++;
      } while (x ++< 1);
printf("%d\t %d\t", x, y);
}
void main()
{
   func();
   func();
}
```

The sum of the printed values is ________.

[NAT 2 Marks]

25. Let $L_1 = aa^* b^+$

$L_2 = ab\,(ab)^*$

$L_3 = L_1 / L_2^*$

The minimal number of states are needed for L_3 in DFA is___.

[MSQ 2 Marks]

26. A ripple counter is required to count from 0 to 255 in decimal with input clock frequency of 512 kHz.

(a) The mod of counter is 8.

(b) The frequency of the output of the eighth FF will be 2 kHz.

(c) The counter starts at 0000 0000. The state of counter after 520 clock pulses will be 0000 1000.

(d) The mod of counter is 256

[MCQ 2 Marks]

27. Consider the following program:

```
#include<stdio.h>
char *p[ ]={"GATE", "Wallah", "2024", "2025"};
char **q[ ]={p, p+3, p+1, p+2};
char ***r = q;
void main()
{
    printf("%s ", **++r);
    printf("%s ", *--*++r+2);
    printf("%s ", *r[-1]+3);
    printf("%s ", r[-1][-1]+1);
}
```

The output is-

(a) 2025 TE 4 024

(b) 2024 Wallah 5 025

(c) 2025 Wallah 5 024

(d) 2025 TE 5 024

[NAT 2Marks]

28. Consider the following statements:

S_1: For given context free language L, checking L is regular.

S_2: For given regular language L, checking L is CFL.

S_3: For given deterministic pushdown automata 'P', non-deterministic push down automata ‘N’ is equivalent to ‘P’.

S_4: Determine whether a given type-3 grammar is ambiguous.

Total number of undecidable statements are_____.

[MCQ 2 Marks]

29. Consider the following program:

```
#include <stdio.h>
void f()
{
 static int a = 3;
 int b = 5;
 a – = b++;
 printf("%d\t%d\n", a, b);
}
int main()
{
     static int a = 2;
     int b = 1;
     f();
     a += 3;
     f();
     printf ("%d\t%d", a, b);
  return 0;
}
```

The output is-

(a)
−2 6
−7 6
5 1

(b)
−2 6
−7 7
5 1

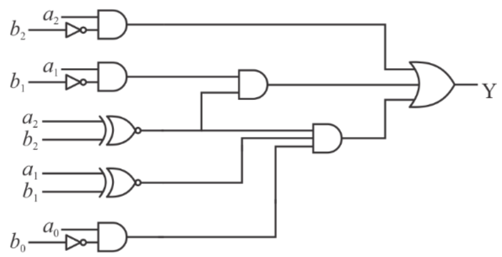
(c)
−2 5
−7 6
5 1

(d) None

30. **[MCQ 2Marks]**

A comparator circuit is designed to compare two modes A and B.

$A = a_2\, a_1\, a_0 \qquad B = b_2\, b_1\, b_0$



Then which of the following is true ?

(a) This circuit compares A and B and output Y is ‘1’ when A = B.

(b) This circuit compares A and B and output Y is ‘1’ when A > B.

(c) This circuit compares A and B and output Y is ‘1’ when B > A.

(d) This circuit gives the final carry output of (A+B) addition.

Answer Key

1. (24)
2. (b)
3. (4)
4. (265)
5. (82)
6. (b)
7. (a, b)
8. (b, c, d)
9. (c)
10. (d)
11. (a, c, d)
12. (a)
13. (12)
14. (2)
15. (b)
16. (12)
17. (c)
18. (c)
19. (a, b, c)
20. (a)
21. (312)
22. (b, d)
23. (c)
24. (18)
25. (4)
26. (b, c, d)
27. (d)
28. (1)
29. (a)
30. (b)

Hints & Solutions

1. (24)

Initialization:
i++ or i=1;
Condition: i++<9 or 1<9 TRUE. i is incremented to 2.
Switch(r() + i) is equivalent to switch(0+2):
case 2 is executed: j=2;
i++; i = 3
Condition: i++<9 or 3<9 TRUE. i is incremented to 4.
Switch(r() + i) is equivalent to switch(1+4):
default and case 2 are executed: j=6;
i++; i=5
Condition: i++<9 or 5<9 TRUE. i is incremented to 6.
Switch(r() + i) is equivalent to switch(2+6):
default and case 2 are executed: j=10;
i++; i=7
Condition: i++<9 or 7<9 TRUE. i is incremented to 8.
Switch(r() + i) is equivalent to switch(3+6):
default and case 2 are executed: j=14;
i++; i = 9
Condition: i++<9 or 9<9 FALSE. i is incremented to 10.
Hence, i + j = 24.

2. (b)

- $L_1 = \{0^m1^n \mid m,n \geq 1\}$

  regular expression = (0*1*)
- $L_2 = \{0^m1^m \mid m \geq 0\}$ CFL

  $\overline{L_2} = (0 + 1)^* - \{0^m1^m \mid m \geq 0\}$

  $L = L_1 \cap \overline{L_2}$

  $L = 0^*1^* \cap \overline{\{0^m1^n \mid m \,!= n\}}$

  $L = \{0^m1^n \mid m\,! = n\}$

Hence, option (b) is correct.

3. (4)

Given function

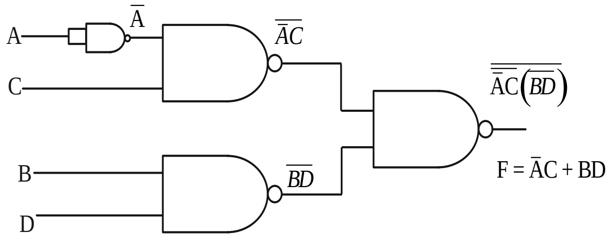
$f = \bar{A}BD + \bar{A}CD + \bar{A}C\bar{D} + AB\bar{C}D + ABCD$

$f = \bar{A}BCD + \bar{A}B\bar{C}D + \bar{A}BCD + \bar{A}\bar{B}CD + \bar{A}BC\bar{D}$
$\quad + \bar{A}\bar{B}C\bar{D} + AB\bar{C}D + ABCD$

k-map of 4 variables

AB \ CD	00	01	11	10
00	0	0	1	1
01	0	1	1	1
11	0	1	1	0
10	0	0	0	0

$f = \bar{A}C + BD$



Hence, 4 NAND gate required.

4. (265)

Number of states in NFA = n + 1
= 8 +1 = 9
Number of states in minimal DFA = 2^8 = 256
Total states (A + B) = 256 + 9 = 265.

5. (82)

Since each region has at least five edges in its boundary, 2|E| > 5(53), or |E| ≥ (1/ 2)(5)(53), and from Theorem, we have
|V| = |E| - 53 + 2 = |E| - 51 ≥ (1/ 2)(5)(53) – 51 = (256/2) – 51 = $81\frac{1}{2}$. Hence |V| ≥ 82.

6. (b)

printf("%s", *(p+3)); //2025 is printed.
printf("%s", *p++); //Parakram is printed. Now p would points to 2024
printf("%s", *(p+++2));//2025 is printed. p then points to Shreshth
printf("%c", **p);//S is printed.

Output: 2025Parakram2025S

7. (a, b)

The given graph is a hamiltonian circuit, it covers all the vertices.
The chromatic number of the graph is 3.
The graph is not an eulerian as the degree of the vertices is not even.

8. (b, c, d)

$(0001\ \ 1101\ .\ 1100)_2 = (1\ D.C)_{16}$

$\uparrow \quad \uparrow \quad \uparrow$

1 D C

Option (a) is not correct

$(001\ \ 001\ .\ 100)_2 = (11.4)_8$

$\uparrow \quad \uparrow \quad \uparrow$

1 1 4

Option (b) is correct

$$(112)_4 = \left(1\times 4^2 + 1\times 1^1 + 2\times 4^0\right)_{10} = (22)_{10}$$

and $(211)_3 = \left(2\times 3^2 + 1\times 3^1 + 1\times 3^0\right)_{10} = (22)_{10}$

Option (c) is correct.

$$(214)_5 = \left(2\times 5^2 + 1\times 5^1 + 4\times 5^0\right)_{10} = (59)_{10}$$

and $(3B)_{16} = \left(3\times 16^1 + 11\times 16^0\right)_{10} = (59)_{10}$

Option (d) is correct.

9. (c)

- Set of real numbers are uncountable and not Turing acceptable.
- Set of prime numbers are decidable and acceptable by Turing machine.

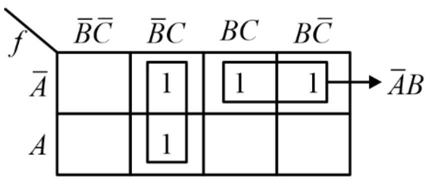
10. (d)

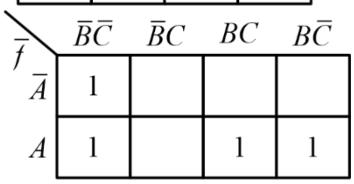
Given $f(A,B,C) = \overline{A}B + \overline{B}C$

$\therefore f_1(A,B,C) = f(f, \overline{f}, A)$

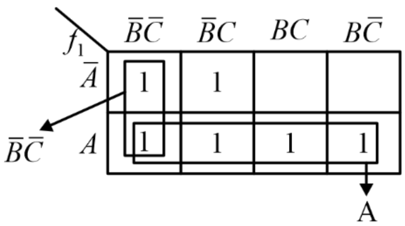
$f_1(A,B,C) = \overline{f}.\overline{f} + \overline{\overline{f}}.A = \overline{f} + fA$

$f_1(A,B,C) = \left(\overline{f} + f\right).\left(\overline{f} + A\right) = \left(\overline{f} + A\right)$





Therefore K-Map of $f_1 = \overline{f} + A$



$f_1(A,B,C) = A + \overline{B}\overline{C}$

11. (a, c, d)

Provided the degree sequence 5, p, 4, 4, 3, q, 2, 1 According to hand-shaking lemma, sum of degree = 2* Number of edges.

5 + p + 4 + 4 + 3 + q + 2 + 1 = 2*edges

19 + p + q = 2*13

19 + p + q = 26

p + q = 7.

Possible value of p and q: 7, 0
6, 1
5, 2
4, 3

Out of these 4 possibilities only 3 will make our degree sequence graphical i.e. {6,1}, {5,2} and {4, 3}.

12. (a)

(a) Halting problem is always undecidable.

(b) Emptiness problem in CFL is always decidable.

(c) Equivalence problem for DCFL is always decidable.

Hence, option (a) is correct.

13. (12)

fun1(5):

if(n < 2) return; //5 < 2 is FALSE

fun2(n-2); //fun2(3) is called.

printf("%d\t", n-2); //3 is printed./*3rd printf() executed*/

fun2(3):

if(n < 1) return;//3 < 1 FALSE

printf("%d\t", n-1);//2 is printed./*1st printf() executed*/

fun1(n – 1);//fun1(2) is called.

fun1(2):

if(n < 2) return; //2 < 2 is FALSE

fun2(n – 2); //fun2(0) is called. It simply returns.

printf("%d\t", n – 2); //0 is printed./*2nd printf() executed*/

fun2(5):

if(n < 1) return; //5 < 1 is FALSE

printf("%d\t", n – 1); //4 is printed./*4th printf() executed*/

fun1(n – 1);//fun1(4) is called.

fun1(4):

if(n < 2) return; //4 < 2 is FALSE

fun2(n – 2); //fun2(2) is called.

printf("%d\t", n – 2); //2 is printed./*6th printf() executed*/

fun2(2):

if(n < 1) return; //2 < 1 is FALSE

printf("%d\t", n – 1); //1 is printed./*5th printf() executed*/

fun1(n – 1);//fun1(1) is called. It simply returns.

Output: 2 0 3 4 1 2

Sum: 12

14. (2)

Given an initial state of 0110, the status of the counter will be 0110 after every 16, 32, 48, 64, and so forth clock pulses. The down counter will then do what the states indicate, as shown below.

After clock pulses	64	65	66	67	68
State of counter	0110	0101	0100	0011	0010
Decimal Value	6	5	4	3	2

15. (b)

L(G_1) $= \{0^n1^n1^m\,2^m \mid m, n \geq 0\}$

$= \{0^n1^{m+n}\,2^m \mid m, n \geq 0\}$

L(G_2) $= \{0^m1^n\,2^n1^m \mid m, n \geq 0\}$

L(G_3) $= \{0^n\,1^{m+n}\,2^m \mid m, n \geq 0\}$

Hence, option (b) is correct.

16. (12)

fun1(5):

if(n < 2) return;// 5 < 2 is FALSE

fun2(n – 2); //fun2(3) is called.

printf("%d\t", n – 2); // 3 is printed./*3rd printf() executed*/

fun2(3):

if(n < 1) return; //3 < 1 FALSE

printf("%d\t", n – 1); // 2 is printed./*1st printf() executed*/

fun1(n – 1); //fun1(2) is called.

fun1(2):

if(n < 2) return;// 2 < 2 is FALSE

fun2(n – 2); // fun2(0) is called. It simply returns.

printf("%d\t", n – 2); //0 is printed./*2nd printf() executed*/

fun2(5):

if(n<1) return;// 5 < 1 is FALSE

printf("%d\t", n –1);//4 is printed./*4th printf() executed*/

fun1(n – 1); // fun1(4) is called.

fun1(4):

if(n < 2) return; // 4 < 2 is FALSE

fun2(n – 2); // fun2(2) is called.

printf("%d\t", n – 2); // 3 is printed./*6th printf() executed*/

fun2(2):

if(n < 1) return; // 2 < 1 is FALSE

printf("%d\t", n – 1); // 1 is printed./*5th printf() executed*/

fun1(n – 1); // fun1(1) is called. It simply returns.

Output: 2 0 3 4 1 2

Sum: 12

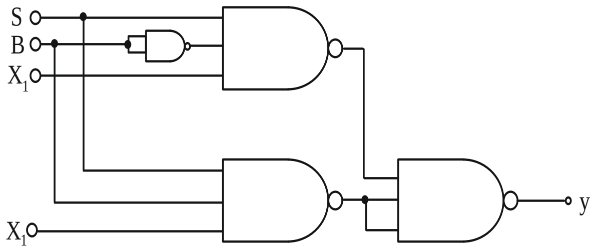
17. (c)

As per design specification, the expressions for output y can be obtained as

$$y = S\bar{B}x_1 + SBx_0$$

$$\bar{y} = \left(\overline{S\bar{B}\,x_1}\right)\left(\overline{SBx_0}\right) \textit{ and } y = \overline{\left(\overline{S\bar{B}\,x_1}\right)\left(\overline{SBx_0}\right)}$$

The NAND gate implementation is show below.



18. (c)

void *p;

char *c="GATEWallah";

int a=513;// Binary of 513 is $(00000010\ 00000001)_2$

p = &a;

printf("%d ", *(char*)p); // Decimal equivalent of 0000001 is printed, i.e 1

p = c; //p stores the base address of the string GATEWallah

printf((char*)p + 4);// Wallah is printed.

return 0;

Output: 1Wallah

19. (a, b, c)

(a) $L_1 \oplus L_2 = (\overline{L_1} \cup L_2) \cup (L_1 \cup \overline{L_2})$

$= \left(\overline{\text{CFL}} \cup \text{DCFL}\right) \cup \left(\text{CFL} \cup \overline{\text{DCFL}}\right)$

$= (\text{CSL} \cup \text{DCFL}) \cup (\text{CFL} \cup \text{CFL})$

$= \text{CSL} \cup \text{CFL}$

$= \text{CSL}$ **Incorrect**

CSL but not CFL

(b) $\left(L_1 \cup \overline{L_3}\right) = \left(CFL \cup \overline{RE}\right)$

= (CFL ∪ Need Not RE)

= Not RE **Incorrect**

(c) $\left(L_2 \cup \overline{L_3}\right) = \left(DCFL \cup \overline{RE}\right)$

= DCFL ∪ Need Not RE

= Not RE **Incorrect**

(d) (L1 ∪ L2 ∪ L3) = CFL ∪ DCFL ∪ RE

= CFL ∪ CFL ∪ RE

= CFL ∪ RE

= RE **Correct**

Hence option (a, b, c) are correct.

20. (a)

```
void main()
{
    int i=printf("Parakram 2024");//i=13
    i=func(i=func(i=func(--i)));
    //func(--i) i.e func(12) returns 9.
    //func(i=9) i.e func(9) returns 6.
    //func(i=6) i.e func(6) returns 3.
    printf("%d", i);//3
}
```

Output: Parakram 20243

21. (312)

In BCD adder. Let the augend be $A = a_3a_2a_1a_0$ and addend be $B = b_3b_2b_1b_0$. Then A and B can vary from 00 to 99 for carry in $C_{in} = 0$ and 00 to 99 for $C_{in} = 1$. Total number of input combinations $= 2^9 = 512$ and total number of valid combinations = 200. So, don’t care input combination = 512 – 200 = 312.

22. (b, d)

P = ab + aQ + bR

Q = baQ + bR

R = Raba + a

Apply Arden’s Theorem:

$R = a(aba)^*$

$Q = (ba)^*bR$

$Q = (ba)^*ba(aba)^*$

P = ab + aQ + bR

P = aQ | bR | ab

= a[(ba)*ba(aba)*] + ba(aba)* + ab

$r^* r = r^+$

$(ba)^*ba = (ba)^+$

$P = a(ba)+ (aba)^* + ba(aba)^* + ab$

Exactly match with option (d)

$P = a[(ba)^* \underline{ba(aba)^*}] + \underline{ba(aba)^*} + ab$

$P = [a(ba)^* + \in]ba(aba)^* + ab$

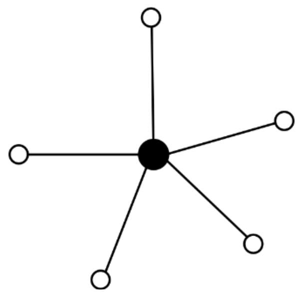
$= ab + [\in + a(ba)^*]ba(aba)^*$

Exactly match with option (b).

Hence, option (b, d) are correct.

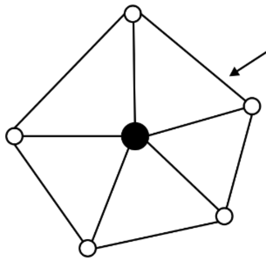
23. (c)

Given graph is $K_{1.n}$



Hamiltonian graph.

resultant graph ⇒



24. (18)

```
func():
int x=-5;
static int y; // y=0
do
{
        x++; //x=-4, -2, 0, 2
        y++; //y=1, 2, 3, 4
}
while(x++<1);
    -4<1→ TRUE. x increments to -3
    -2<1→ TRUE, x increments to -1
    0<1 → TRUE, x increments to 1
    2<1 → FALSE. x increments to 3 STOP
printf("%d\t%d\t", x,y); //3 4 is printed.
func():
```

```
int x=-5;
static int y; // y=4
do
{
        x++; //x=-4, -2, 0, 2
        y++; //y=5, 6, 7, 8
}
while(x++<1);
```
-4<1→ TRUE. x increments to -3
-2<1 → TRUE, x increments to -1
0<1 → TRUE, x increments to 1
2<1 → FALSE. x increments to 3 STOP
printf("%d\t%d\t", x,y);// 3 8 is printed.

Output: 3 4 3 8

Sum: 18

25. (4)

$L_1 = aa^* b^+$
$\quad = a^+ b^+$
$L_2 = ab\,(ab)^*$
$\quad = (ab)^+$

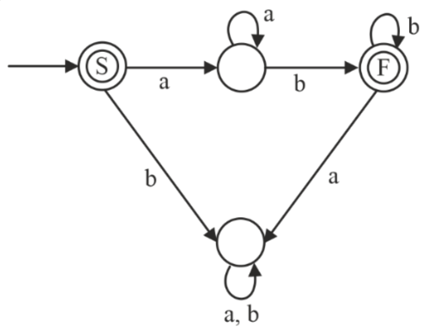
$$L_2^* = \left[(ab)^+\right]^*$$

$$L_2^* = (ab)^*$$

$$L_3 = \frac{a^+b^+}{(ab)^*}$$

$= a^+ b^+ + \in$
$= aa^* bb^* + \in$

DFA:



Number of states = 4

26. (b, c, d)

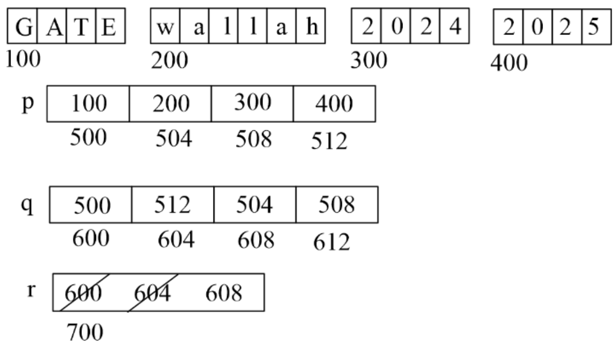
The counter will have the number of distinct states equal to 256, mod = 256.

The frequency of output of eighth FF will be 512/256 = 2 kHz.

Starting from 0000 0000 the counter will be back to 0000 0000 every after 256 clock pulses.

After 512 clock pulses, the state will be 0000 0000 and after 520 (512 + 8) clock pulses, the state will be 0000 1000.

27. (d)



printf ("%S", **++r);

**604

*512

*400 → 2025 is printed.

printf ("%S", *_ _*++r+2)

*_ _*608 + 2

*_ _ 504 + 2

*500 + 2

102 → TE is printed.

printf ("%S", *p[-1] + 3)

**604 + 3

*512 + 3 = 403 → 5 is printed.

printf("%S", p[-1][-1]+1); //301 → 024 is printed.

Output: 2025 TE 5 024

28. (1)

- If the language is CFL, DCFL, CSL and recursive then language may /may not be regular. So, the problem is **undecidable**.
- If the language is regular then surely language will be DCFL, CFL, CSL recursive and RE also. Hence, the problem is **decidable**.
- NPDA $\geq$ DPDA

  For every DPDA, NPDA exits but vice versa not true. **(Decidable)**.
- Type-3 is regular grammar. **(Decidable)**.

29. (a)

f():
static int a=3;
    int b=5;

a $\leq$ b++; //a = 3-5=-2; b is incremented to 6.

printf("%d\t%d\n",a,b); //-2 6 is printed.

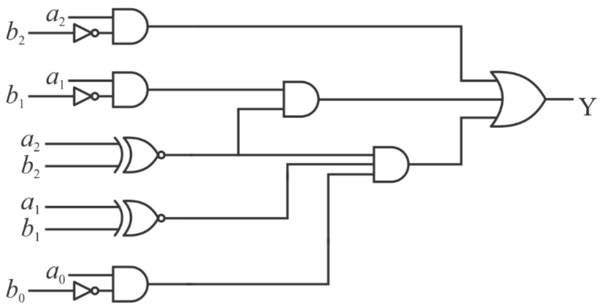
f():
static int a=3; // a contains -2.

```
int b=5;

a-=b++; //a=-2-5=-7; b is incremented to 6.

printf("%d\t%d\n",a,b); //-7 6 is printed.
main():
static int a=2;
int b=1;
a+=3; //a=5
printf("%d\t%d\n",a,b); //5 1 is printed.
```

$$\text{Output: } \begin{matrix} -2 & 6 \\ -7 & 6 \\ 5 & 1 \end{matrix}$$

30. (b)

Lets draw the circuit and analyze it :



Output Y is

$$Y = a_2\bar{b}_2 + (a_2\ b_2)a_1\odot \bar{b}_1 + (a_2\odot b_2)(a_1\odot b_1)a_0\bar{b}_0$$

- This output is nothing but a comparator output when designed for (A > B) so output will be ‘1’ when (A > B).
- For $A < B \rightarrow$

$$y_1(A < B) = \bar{a}_2 b_2 + (a_2\odot b_2)\bar{a}_1 b_1 + (a_2\odot b_2)(a_1\odot b_1)\bar{a}_0 b_0$$

- For $A = B \rightarrow$

$$y_1(A = B) = (a_2\odot b_2)(a_1\odot b_1)(a_0\odot b_0)$$

Hence, output Y will be ‘1’ when A > B.

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 01

Subject : Theory of Computation

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. How many states are required in minimal DFA for regular expression $(a^*b^* + b^*(a^*b^*)^* + ab)$ on alphabet $\Sigma = \{a, b\}$?

(a) 3 (b) 4
(c) 5 (d) 1

[MCQ]

2. Let, $L_1 = a^*b^*$
$L_2 = b^*a^*$
$L_1 - L_2$

(a) ϕ (b) $\in$
(c) a^+b^+ (d) $a^* + b^*$

[NAT]

3. For regular expression $(ab^*b + a)(bba)(a^*b^*)(a + b)$, the length of the shortest string will be_____.

[MSQ]

4. Consider a regular expression:
Regular expression: $(10^* + 1)^* \cup (11 + 0)^*$
Which of the following string is/are generated by above regular expression?

(a) 1011011 (b) 0110110
(c) 0001110 (d) 1111111

[MCQ]

5. For language $L = \{w_1aaw_2 | w_1, w_2 \in \{a + b\}^* |w_1| < 3$ $\{|w_2| \leq 1\}$
Which of the following will be correct regular expression?

(a) $(\in + a + b)^3$ aa $(a + b)$
(b) $(a + b)^3$ aa $(a + b)$
(c) $(\in + a + b)^2$ aa $(\in + a + b)$
(d) $(a + b)^2$ aa$(a + b)$

Q.6 to 10 Carry TWO Mark Each

[MCQ]

6. Consider the following statements:
S_1: Complement of finite language always infinite.
S_2: Complement of infinite language can be finite.
S_3: Complement of infinite language can be infinite.
S_4: Complement of infinite language always finite.
Which of the following is correct?

(a) S_1 and S_2 are correct.
(b) S_1, S_2 and S_4 are correct.
(c) S_1, S_2 and S_3 are correct.
(d) S_1 and S_4 are correct.

[MCQ]

7. Let a language (L) = {ab, ba, aa, b}. Then what is the highest power of language to generate the string aaabbabb?

(a) L^5 (b) L^4
(c) L^6 (d) None of these

[MCQ]

8. For language $L = \{a^n | n \geq 0\}$ on alphabet $\Sigma = \{a\}$. What will be the correct regular expression for L^3?

(a) $L^3 = \{a^{3n} | n \geq 0\}$
(b) $L^3 = \{a^n | n \geq 0\}$
(c) $L^3 = \{a^{3^n} | n \geq 0\}$
(d) None of these

[NAT]

9. How many states are required for language $L = \{a^m b^n c^q \mid m, n, q \geq 0\}$ on alphabet $\Sigma = \{a, b, c\}$?______

[NAT]

10. Consider a language L on $\Sigma = \{a, b\}$, L = {w ; number of a's = 2 and number of b's = even} how many states are required in DFA to accept $\overline{L}$? __________.

Answer Key

1. **(d)**
2. **(c)**
3. **(5)**
4. **(a, b, d)**
5. **(c)**
6. **(c)**
7. **(a)**
8. **(b)**
9. **(4)**
10. **(7)**

Hints and solutions

1. (d)

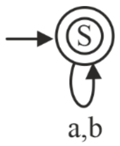
Regular expression $= a^*b^* + b^*(a^*b^*)^* + ab$

$= a^*b^* + b^*(a + b)^* + ab$

$= (a + b)^*$

$(a + b)^*$ will cover each and every string.

Minimal DFA:



Number of states = 1

2. (c)

$L_1 – L_2 = a^+ b^+$

3. (5)

$$\underbrace{(ab^*b + a)}_{a}\ \underbrace{(bba)}_{bba}\ \underbrace{\left(a^*b^*\right)}_{\in}\ \underbrace{(a + b)}_{a\,/\,b}$$

Shortest string $= abba \in a$

$= abbaa$

$= 5$

4. (a, b, d)

Regular expression $= (10^* + 1)^* + (11 + 0)^*$

(a) $\underline{10}\ \underline{11}\ \underline{00}\ \underline{11}$ Possible

(b) $\underline{0}\ \underline{11}\ \underline{0}\ \underline{11}\ \underline{0}$ Possible

(c) $\underline{0}\ \underline{0}\ \underline{0}\ \underline{11}\ \underline{1}\ \underline{0}$ Not Possible

(d) $\underline{1}\ \underline{1}\ \underline{1}\ \underline{1}\ \underline{1}\ \underline{1}\ \underline{1}$ Possible

Note: Take either first regular expression or second regular expression but don't take both.

5. (c)

- $|w_1| < 3$: length of the string can be 0 length or 1 length or 2 length

  $|w_1| < 3: (\in + a + b)^2$
- $|w_2| \leq 1$: length of the string can be either 0 length or 1 length

  $|w_2| \leq : (\in + a + b)^1$

Regular expression $= (\in + a + b)^2\ aa\ (\in + a + b)$

Hence, option (c) is correct.

6. (c)

S_1 True: $\overline{a.b} = (ab)^+$

S_2 True: $\overline{(a.b)}^* = \phi$

S_3 True: $\overline{a(a+b)^*} = b(a+b)^* + \in$

S_4 True: $\overline{(a+b)^*} = \phi$

$\overline{a(a+b)^*} = b(a+b)^* + \in$

- Complement of finite language always infinite.
- Complement of infinite language can be finite or infinite.

Hence, option (c) is correct.

7. (a)

String = aabbabb

L = {ab, ba, aa, b}

$\Rightarrow \underbrace{a\,a}_{L}\ \underbrace{b}_{L}\ \underbrace{b}_{L}\ \underbrace{a\,b}_{L}\ \underbrace{b}_{L}$

$\Rightarrow L^5$

Hence, option (a) is correct.

8. (b)

$L = \{an \mid n \geq 0\}$

$= \{\in, a, aa, aaa, \ldots\}$

$= a^*$

$L^2 = L * L$

$= a^* \times a^*$

$= a^*$

$L^3 = L^2 * L$

$= a^* \times a^*$

$= a^*$

$L = \{a^n \mid n \geq 0\}$

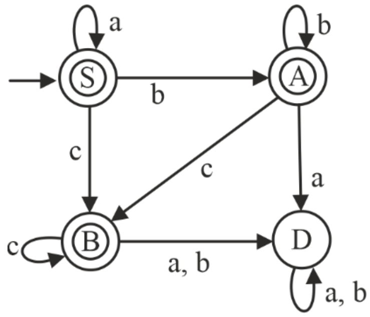
Hence, option (b) is correct.

9. (4)

L= $\{a^m b^n c^q \mid m, n, q \geq 0\}$

L= $\{a^*, b^*, c^*, aa \ldots bb \ldots cc \ldots\}$

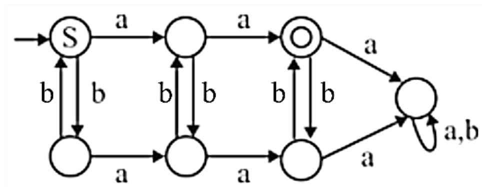
MDFA:



10. (7)

Range 7 to 7

- This type of language can be design by grid(mod) machine.



- Number of states in DFA is same as number of states in complement of DFA.
- So, number of states in $\overline{L}$ = 7.

Branch : CSE & IT **Batch: Hinglish**

WEEKLY TEST – 02

Subject : Theory of Computation

Topic : Finite Automata

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. For language $L = \{w \mid w \in \{a, b\}^*\}, |w| = 4\}$. How many states are required in NFA for above language?

(a) 4 (b) 5

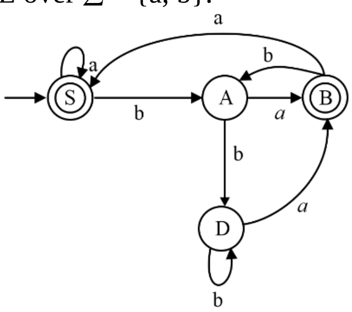
(c) 6 (d) None of these

[NAT]

2. For language $L = \{X\ a\ w \mid X, w \in \{a, b\}^*, |X| = 1\}$. Minimum number of states required in finite automata (NFA) is ______.

[NAT]

3. Consider the following DFA that accepts regular language L over $\sum = \{a, b\}$.



How many states in equivalent minimized DFA that accepts the language?_____.

[NAT]

4. Let

$L_1 = a^* b^*$

$L_2 = b^*a^*$

$L_3 = (a + b)^*$

$L_4 = a^* b^* a^*$

$L = (L_1 \cap L_2) - (L_3 \cap L_4)$

Number of strings in above language L will be ______.

[MCQ]

5. Consider a regular expression (R):

$R = (a + b)^* (a + b)^2 (a + b)^*$.

How many equivalences classes are existing for above regular expression R?

(a) 2 (b) 3

(c) 4 (d) None

Q.6 to 10 Carry TWO Mark Each

[MCQ]

6. Consider the language L given by the regular expression $(a + b)^* ab(a + b)^*$ over the alphabet {a, b}. What is the correct regular expression of $\overline{L}$?

(a) $(a + b)^* (ab + ba + bb + aa) + \in$

(b) $(a^* b^*)^* (ba + bb + aa) (a^*b^*)^* + a + b$

(c) $(a + b)^* ba (a + b)^* + a + b$

(d) $(a + b)^* (ba + bb + aa) (a + b)^* + \in + a + b$

[MSQ]

7. Which of the following option is/are correct?

(a) For $L = \{w|w \in \{a, b\}^*, |w| = 5\}$ Minimum number of states in DFA is 7.

(b) For $L = \{w|w \in \{a, b\}^* |w| \leq 5\}$ minimum number of stater in NFA is 6.

(c) $L = \{w|w \in \{a, b\}^*\}$, 6th symbol from begin is 'a'} minimum number of states in DFA is 64.

(d) $L = \{w|w \in \{a, b\}^*\}$, 10th symbol from ends is 'a'} minimum number of states in DFA is 1024.

[MCQ]

8. Consider the following statements:

S_1: If a finite automata M with n states accepts a string of length w, $w \geq n$ then surely L(M) is infinite.

S_2: If a finite automata m with n states accepts a string of length w, $w < n$ then, surly L(M) is finite.

S_3: The pumping length for any regular language is unique.

Which of the following is correct:

(a) S_1 and S_2 are correct.

(b) S_1 and S_3 are correct.

(c) S_2 and S_3 are correct.

(d) None of this.

[MSQ]

9. For language L = {Every odd bit is a}

On alphabet $\Sigma = \{a, b\}$. Which of the following is/are correct regular expression?

(a) $(aa + ab)^* (\in + a)$

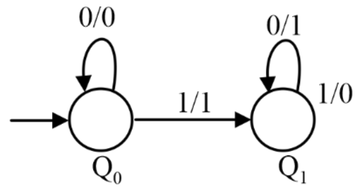
(b) $(aa + ab + ba + b)^*a$

(c) $(aa + ba)^*(\in + a + b)$

(d) $(a(a + b))^* + (a(a + b))^* a$

[MCQ]

10. The following diagram represents a finite state machine which takes as input a binary number from the least significant bit



Which one of the following is TRUE?

(a) It computes 1's complement of the input number

(b) It computes 2's complement of the input number

(c) It increments the input number

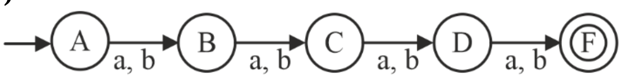
(d) It decrements the input number

Answer Key

1. (b)
2. (3)
3. (2)
4. (0)
5. (b)
6. (d)
7. (a, b, d)
8. (d)
9. (a, d)
10. (b)

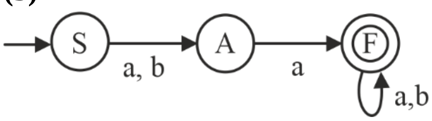
Hints and solutions

1. (b)



Number of states = 5

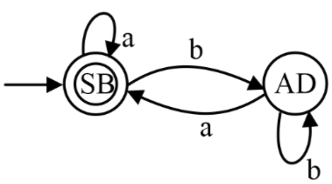
2. (3)



Number of states = 3

The above NFA represents the language where 2nd symbol is 'a'.

3. (2)



Number of states = 2

4. (0)

$L_1 \cap L_2 = a^* + b^*$

$L_3 \cap L_4 = a^* b^* a^*$

$L = (a^* + b^*) - a^*b^*a^*$

$= \phi$

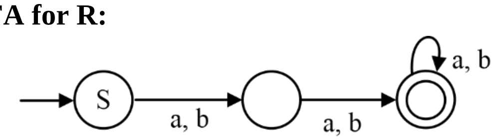
Number of strings = 0

5. (b)

$R = (a + b)^* (a + b)^2 (a + b)^*$

Number of equivalence classes in my hill Nerode = Number of states in minimal DFA

DFA for R:



Number of states = 3

Number of equivalence classes = 3

6. (d)

$L = (a + b)^* ab (a + b)^*$

L = {containing 'ab' as a substring}

$\bar{L} = \{(a + b)^* (ba + bb + aa) (a + b)^* + \in\}$

7. (a, b, d)

(a) $n + 2 = 5 + 2 = 7$ states DFA

(b) $n + 1 = 5 + 1 = 6$ states NFA

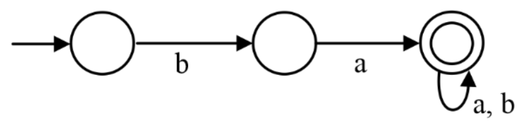
(c) $n + 2 = 6 + 2 = 8$ states DFA

(d) $2^n = 2^{10} = 10^{24}$ states DFA

Hence, (a, b, d) are correct.

8. (d)

S_1 True:



$n = 3$

$(w) \geq 3$

For 3 length there must be a loop an any state. **S_2 False:**

$|w| < n$

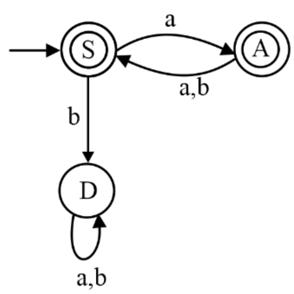
$2 < 3$

S2 will be true If and only if all the strings where $| w | < n$.

S_3 False:

Minimum pumping length is unique.

9. (a, d)



FA:

Regular expression = $(a(a + b))^* a + (a (a + b))^* a$

$= (a(a + b))^* (\in + a) : (aa + ab)^*(\in + a)$

Hence, (a, d) are correct.

10. (b)

It computes 2's complement of the input number

Branch : CSE & IT **Batch : Hinglish**

WEEKLY TEST – 03

Subject : Theory of Computation

Topic : NFA and Regular Language

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

[MCQ]

1. Which of the following is a regular language?

(a) $L = \{a^{n^n} \mid n \geq 1\}$

(b) $L = \{a^{m^n} \mid n \geq 1, m = n^2\}$

(c) $L = \{a^{m^n} \mid n \geq 1, m > n\}$

(d) None of these

[MCQ]

2. Which of the following is a non-regular language?

(a) $L = \{wxwy \mid x,y,w \in (a + b)^+\}$.

(b) $L = \{xwyw \mid x,y,w \in (a + b)^+\}$.

(c) $L = \{wxyw \mid x,y,w \in (a + b)^+\}$.

(d) All of the above.

[MCQ]

3. Let L be any formal language. If L^* is regular language then what is L?

(a) L is regular.

(b) L is non-regular.

(c) L is CFL.

(d) None of these.

[MCQ]

4. Consider the following two statements:

[I]: There exist a regular language L_1, such that for all language L_2, $L_1 \cup L_2$ is always regular.

[II]: If all states of deterministic finite automata (DFA) except start state are final states then language accepted by DFA is Σ^+.

Which of the following is correct?

(a) S_1 only.

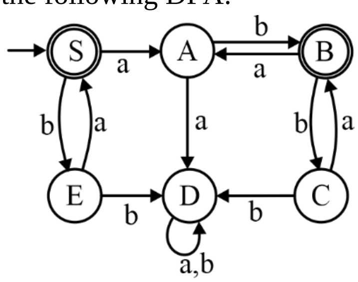
(b) S_2 only.

(c) Both S_1 and S_2 are true.

(d) None of these.

[MCQ]

5. Consider the following DFA:



The correct transition of $\delta^*(S, abaab)$ is?

(a) {D}

(b) {S, A, B, D}

(c) {A, B, A, D, D}

(d) {B, D}

Q.6 to 10 Carry TWO Mark Each

[MCQ]

6. Assume R_1, R_2 and R_3 are three regular expressions. Given, $R_1 + R_2R_3 = (R_1 + R_2)(R_1 + R_3)$ for any R_2 and R_3. Which of the following could be correct condition which always satisfies the above equation?

(i) $R_1 = R_2$

(ii) $R_1 = R_3$

(iii) $R_1 = \phi$

(a) Only (i) and (ii) are correct.

(b) Only (i) and (iii) are correct.

(c) Only (ii) and (iii) are correct.

(d) (i), (ii) and (iii) are correct.

[MCQ]

7. Consider the following statements:

[I]: Concatenation of two finite language cannot be commutative until at least one of them is empty or null.

[II]: Let L be language, reversal of L does not contain any string present in language L except $\in$.

Which of the following is correct?

(a) (I) only.

(b) (II) only.

(c) Both (I) and (II) are correct.

(d) None of these.

[NAT]

8. Let us consider the following regular expression $R = a^*b^* + b^*a^*$.

How many equivalence classes of expression that represent language are equivalent to regular expression R?

[MSQ]

9. Consider the following languages:

$L_1 = \{a^m b^n c^p \mid m, n, p \geq 0\}$.

$L_2 = \{a^m b^m c^p \mid m, p \geq 0\}$.

$L_3 = \{a^{2m} b^{2m} c^p \mid m, p \geq 0\}$.

Which of the following is/are correct?

(a) $L_1 \subseteq L_2$ and $L_2 \subseteq L_1$.

(b) $L_2 \subseteq L_1$ and $L_3 \subseteq L_1$.

(c) $L_3 \subseteq L_2$ and $L_2 \subseteq L_1$.

(d) $L_2 \subseteq L_3$ and $L_3 \subseteq L_1$.

[MCQ]

10. Consider the following languages L_1 and L_2:

$L_1 = \{0^m 1^n \mid m = n, m, n \geq 0\}$

$L_2 = \{0^m 1^n \mid m, n \geq 0\}$

Let, $L = L_2 - L_1$, then what is the language L?

(a) $L = \{0^m 1^n \mid m, n \geq 0\}$.

(b) L is regular.

(c) $L = \{0^m 1^n \mid m \neq n\}$, non-regular.

(d) $L = \{0^m 1^n \mid m \neq n\}$, regular.

Answer Key

1. (c)
2. (c)
3. (d)
4. (a)
5. (c)
6. (d)
7. (d)
8. (6)
9. (b, c)
10. (c)

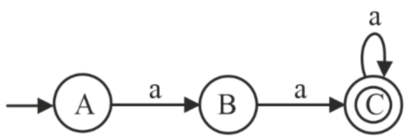
Hints and Solutions

1. (c)

$L = \{a^{m^n} \mid n \geq 1, m > n\}$

$\Rightarrow L = \{a^{m^1} \mid m \geq 2\} \cup \{a^{m^2} \mid m \geq 3\} \cup \ldots$

$\Rightarrow L = \{a^i \mid i \geq 2\}$ is a regular language.



This accepts L.

2. (c)

(a) $L = \{wxwy \mid x, y, w \in (a+b)^+\}$

$L = [a(a + b)^+ a(a + b)^+] + [b(a + b)^+ b(a + b)^+]$

$\Rightarrow$ L is regular language.

(b) $L = \{xwyw \mid x, y, w \in (a + b)^+\}$

$L = [(a + b)^+ a(a + b)^+ a] + [(a + b)^+ b(a + b)^+ b]$

$\Rightarrow$ L is regular language.

(c) $L = \{wxyw \mid x, y, w \in (a + b)^+\}$

$\Rightarrow$ L is non-regular language.

3. (d)

If L^* is regular, L may or may not be a regular.

Example 1: $L^* = (a + b)^*$ is regular, $L = (a + b)$ is regular.

Example 2: $L^* = \{(a^P)^* \mid P \text{ is prime}\}$ is regular but $L = \{a^P \mid P \text{ is prime}\}$ is non-regular.

$\therefore$ Option (d) is correct.

4. (a)

S_1 True:

$L_1 = \Sigma^*$

$L_1 \cup L_2 = \Sigma^* \cup L_2 = \Sigma^*$ (Regular)

S_2 False:

May or may not be Σ^+

For example: DFA for language ending with "a" on alphabet {a, b}.

5. (c)

$\delta^*(S, abaab) =$ a b a a b

A B A D D

So, answer will be (c)

6. (d)

$R_1 + R_2R_3 = (R_1 + R_2)(R_1 + R_3)$

(i) If $R_1 = R_2$,

$R_1 + R_2R_3 = (R_1 + R_2)(R_1 + R_3)$

$R_2 + R_2R_3 = (R_2 + R_2)(R_2 + R_3)$

$R_2 + R_2R_3 = R_2(R_2 + R_3)$

$= R_2 + R_2R_3$ is correct.

(ii) If $R_1 = R_3$,

$R_1 + R_2R_3 = (R_1 + R_2)(R_1 + R_3)$

$R_3 + R_2R_3 = (R_3 + R_2)(R_3 + R_3)$

$= (R_2 + R_3)R_3$

$= R_3 + R_2R_3$ is correct.

(iii) If $R_1 = \phi$,

$R_1 + R_2R_3 = (R_1 + R_2)(R_1 + R_3)$

$\phi + R_2R_3 = (\phi + R_2)(\phi + R_3)$

$R_2R_3 = R_2 R_3$ is correct.

$\therefore$ (i), (ii) and (iii) conditions are correct.

7. (d)

[I]: $L_1 = \{a\}$

$L_2 = \{a\}$

$L_1 \cdot L_2 = a \cdot a$

$L_2 \cdot L_1 = a \cdot a$

Commutative

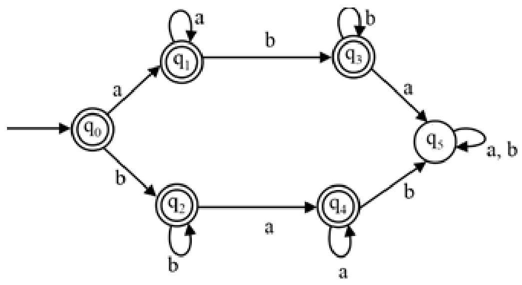
[II]: $L = (a + b)^*$

$L^R = (a + b)^*$

Hence, option (d) is correct.

8. (6)

$R = a^*b^* + b^*a^*$



$R = a^*b^* + b^*a^*$

$= (\in + aa^*) = (\in + bb^*) + (\in + bb^*)(\in + aa^*)$

$= \in + aa^* + bb^* + aa^* bb^* + bb^* aa^*$

$[\because a^* = (\in + aa^*)]$

Number of equivalence classes are equivalent to minimum number of states in DFA.

Regular expression for each state represents each equivalence class.

So,

$[q_0] = \in$

$[q_1] = aa^*$

$[q_2] = bb^*$

$[q_3] = aa^* + bb^*$

$[q_4] = bb^* aa^*$

$[q_5] = (aa^*bb^*a + bb^*aa^*b)(a + b)^*$

9. (b, c)

- $L_3 \subseteq L_1$ True
- $L_2 \subseteq L_1$ True
- $L_3 \subseteq L_2$ True

(a)	False	(b)	True
(c)	True	(d)	False

10. (c)

$L_1 = \{0^m1^n \mid m = n, m, n \geq 0\}$

$L_2 = \{0^m1^n \mid m, n \geq 0\}$

$L = L_2 - L_1$

$= L_2 \cap \overline{L_1}$

$= (0^*1^*) \cap \{0^m1^n \mid m \neq n\}$

$= \{0^m1^n \mid m \neq n\}$ non-regular (CFL)

Branch : CSE & IT **Batch: Hinglish**

WEEKLY TEST – 04

Subject : Theory of Computation

Finite Automata

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

1. **[MSQ]**
Consider the following language:
$L_1 = \{a^n b^m c^n \mid m,n \geq 0\}$
$L_2 = \{a^n c^n \mid n \geq o\}$
Which of the following is/are correct.
(a) L_1 & L_2 are both DCFL.
(b) $L_2 - L_1$ is regular but not finite.
(c) $L_1 . L_2$ is CFL.
(d) $L_1 . L_2^R = \{a^n b^m c^{n+q} a^q \mid m, n, q \geq 0\}$

2. **[MSQ]**
Which of the following statement is/are correct?
(a) The intersection of CSL with complement of regular language may be a CFL.
(b) The intersection of regular language with complement of CFL may be regular.
(c) The complement of RE is Not RE.
(d) The complement of Not RE is Not RE.

3. **[NAT]**
The number of wrong statement from the following:
(i) Superset of CFL can be regular.
(ii) Regular language can also have represented using non- regular grammar.
(iii) NPDA is more powerful than DPDA.
(iv) If L_1 & L_2 are context free languages then $L_1 \cap \overline{L_2}$ is context free language.
(v) The intersection of CFL with infinite language need not to be CFL.____

4. **[MSQ]**
Which of the following is/are undecidable?
(a) Given CFG is ambiguous or not.
(b) Given grammar is CFG or not
(c) For CFG G, L(G) contains a palindrome
(d) For two CFG G_1 & G_2, $L(G_1) \cap L(G_2) = \phi$

5. **[MCQ]**
Consider the following statements:
S_1: It is undecidable whether L(G) is regular for CFG G.
S_2: It is undecidable whether L(G) = regular for context free grammar G.
Choose the correct statement from the following.
(a) S_1 is true, S_2 is false
(b) S_1 is false, S_2 is true
(c) Both S_1 and S_2 are true.
(d) Both S_1 and S_2 is are false

Q.6 to 10 Carry TWO Mark Each

[MCQ]

6. Consider two languages L_1 and L_2. L_1 is regular and L_2 is deterministic context free language.

$$L = \overline{L_1} \cup \left(\overline{L_1} \cap \overline{L_2}\right) \cup L_2$$

Then the language L will be

(a) DCFL (b) CFL

(c) Regular (d) None of these

[MCQ]

7. A context free grammar without any useless symbol is known as ____.

(a) Simplified CFG.

(b) Non-redundant CFG

(c) Inherent CFG

(d) None of these

[MCQ]

8. Which of the following is reduced CFG for the below grammar:

G: $S \to AB \mid cd$

$A \to Bb \mid a \mid \in$

$B \to abBC \mid bb \mid \in$

$C \to aA \mid cD \mid c$

$D \to bB \mid dD \mid d$

(a) $S \to aBb \mid cd$

$A \to Bbb \mid a$

$B \to bb \mid abBc$

$C \to aA \mid cD \mid c$

$D \to bB \mid dD \mid d$

(b) $S \to AB \mid cd$

$A \to Bb \mid a \mid \in$

$B \to abBc \mid bb \mid \in$

(c) $S \to cd \mid abb \mid Bbbb \mid \in$

$A \to bbb \mid a \mid abbbc \mid abcb$

$B \to abc \mid abbbc \mid ababbbcc$

$C \to aa \mid cd \mid c$

(d) None of these

[NAT]

9. Consider the following statements

(i) Subsequence of regular language is regular.

(ii) Regular languages is closed under substitution.

(iii) Superset of regular language is regular.

(iv) Subset of regular language is regular.

How many of the above statements are true?______.

[MCQ]

10. Consider the following context free grammar:

$S \to 0S0 \mid 1S1 \mid 1 \mid 0 \mid \in$

For the above CFG, the total number of odd length strings generated whose length is less than or equal to 0 is ____.

(a) 8 (b) 29

(c) 14 (d) 22

Answer Key

1. (a, c, d)
2. (a, b)
3. (1)
4. (a, c, d)
5. (c)
6. (b)
7. (b)
8. (b)
9. (2)
10. (c)

Hints and Solutions

1. (a, c, d)

Sol. (A) $L_1 = \{a^n b^m c^n \mid m,n \geq 0\}$ is DCFL

$L_2 = \{a^n c^n \mid n \geq 0\}$ is also DCFL

So, option A is correct.

(B) $L_2 - L_1 = L_2 \cap \overline{L_1}$

$L_2 - L_1 = L_2 - (L_1 \cap L_2)$

$= L_2 - (a^n c^n)$

$= \phi$

ϕ is regular and finite. So, option B is incorrect.

(C) $L_1 \cdot L_2$ = DCFL· DCFL [DCFL ar closed under

= DCFL concatenation]

$\therefore$ DCFL is subset of CFL

So, $L_1 \cdot L_2$ is CFL, Hence option C is correct.

(D) $L_1 . L_2^R = \{a^n b^m c^{n+q} \mid m, n, q \geq 0\}$

$L_1 = \{a^n b^m c^n \mid m,n \geq 0\}$

$L_2 = \{a^n c^n \mid n \geq 0\}$

$L_1 . L_2^R = \{a^n b^m c^n c^q a^q\}$

$= \{a^n b^m c^{n+q} a^q\}$

So, D is also correct.

2. (a, b)

Sol. (A) CSL $\cap$ $\overline{\text{Reg}}$ = CSL $\cap$ Reg = CSL

$\because$ CFL $\subseteq$ CSL

So, the language may be a CFL. Correct

(B) Reg $\cap$ $\overline{\text{CFL}}$ = Reg $\cap$ CSL = CSL

$\because$ Reg $\subseteq$ CFL $\subseteq$ CSL

So, the language may be regular correct.

(C) RE not closed under complement. So it may be RE and may not be RE. Incorrect

(D) Not RE are not closed under any operation so, Incorrect.

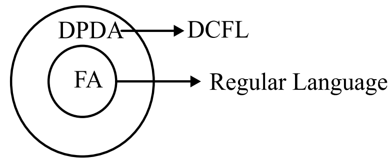
3. (1)

Sol. (i) Superset of CFL can be regular.

$(a+b)^* \quad \supset \quad (a^n b^n)$

$\uparrow \qquad\qquad \uparrow$

Regular CFL



(ii) Eevery regular language is DCFL also. So every regular langauge can be generated by DPDA or PDA or LBA or TM.

(iii) NPDA $\supseteq$ DPDA So, True.

(iv) L_1 & L_2 are CFL. CFL are not closed under complementation and intersection. So this statement is false.

(v) CFL $\cap$ infinite = Need not to be CFL, need not to be finite.

So, correct statement.

4. (a, c, d)

Sol. (a) Given CFG is ambiguous or not. It is undecidable

(b) Given grammar is CFG or not. It is deciable

(c) For CFG G, L(G) contains a palindrome. It is undecidable

(d) For two CFG G_1 & G_2, $L(G_1) \cap L(G_2) = \phi$. It is undecidable

5. (c)

Sol. S_1:

Start with a fixed nonregular context-free language $L_0 \subseteq \Sigma^*$ Let # be a symbol not in Σ. Now for given G consider $L_1 = L_0 \# \Sigma^* \cup \Sigma^* \# L(G)$. L_1 is context-free. We argue that L_1 is regular iff $L(G) = \Sigma^*$. Assume we find a string $w \notin L(G)$ then $L_1 \cap (\Sigma^* \# w) = L_0 \# w$. As L_0 is nonregular, also $L_0\#w$ is nonregular. Context-free languages are closed under intersection with regular languages so L1 cannot be regular. On the other hand, when $L(G) = \Sigma^*$ then $L_1 = \Sigma^*\#\Sigma^*$, which is regular. So deciding regularity of L1 would be equivalent to deciding whether $L(G) = \Sigma^*$, which is impossible.

S_2: it is undecidable

So, option C is correct.

6. (b)

$$L = \overline{L_1} \cup \left(\overline{L_1} \cap \overline{L_2}\right) \cup L_2$$

$$L = \overline{Reg} \cup \left(\overline{Reg} \cap \overline{DCFL}\right) \cup DCFL$$

$$= Reg \cup (Reg \cap DCFL) \cup DCFL$$

$$= Reg \cup DCFL \cup DCFL$$

$$= Reg \cup CFL$$

$$= CFL$$

7. (b)

A context-free grammar without any useless symbol is known as reduced context-free grammar or non-redundant CFG.

Therefore, option (b) is correct.

8. (b)

Reduced CFG means removal of all useless symbols from CFG.

After removing all useless symbols from above grammar it will become

$S \to AB \mid cd$

$A \to Bb \mid a \mid \in$

$B \to abBC \mid bb \mid \in$

$\therefore$ option (b) is correct.

9. (2)

Regular language are closed under subsequence, substitution.

Whereas regular language are not closed under superset and subset.

Therefore, (i), (ii) are true.

10. (c)

Odd-length strings:

Number of 1-length string = 2

Number of 3-length string = 4

Number of 5-length string = 8

Total string = 2 + 4 + 8 = 14

$\therefore$ option (c) is correct.

Branch : CSE & IT Batch:Hinglish

WEEKLY TEST – 05

Subject : Theory of Computation

Maximum Marks 15

Q.1 to 5 Carry ONE Mark Each

1. [MCQ]
Consider the following language:
$L_1 = a^n b^n c^*$
$L_2 = a^* b^n c^n$
If $L = L_1 \cap L_2$
Which of the following is correct about L?
(a) CFL not DCFL
(b) CFL
(c) CSL not CFL
(d) None of these

2. [MCQ]
Consider the following statements, which of the following is true?
(a) Intersection of DCFL with CFL are CFL.
(b) Intersection of CFL with CFL need not to be CFL.
(c) Intersection of set of all CFL's with set of all regular is always DCFL.
(d) Intersection of infinite language with CFL need to be CFL.

3. [MCQ]
What does the following transition means:
$\delta(q, b) = \delta(q' W,R)$
(a) Read W, write w, Move Right
(b) Read b, write W, Move Right
(c) Read W, Read b, Move Right
(d) Read b, Read b, Move Right

4. [MSQ]
Which of the following statement is/are correct?
(a) Turing machine always halt for valid strings
(b) Turing machine may halt for invalid strings
(c) Turing machine accepts recursively enumerable language
(d) Halting Turing machine accepts recursively enumerable language

5. [NAT]
Consider the following grammar.
$S \to ABCS|E$
$A \to a$
$B \to b$
$C \to c$
Total number of states in minimal DFA of above grammar is_______.

Q.6 to 10 Carry TWO Marks Each

6. [MCQ]
Consider the following statements:
(i) $L_1 = \{xyx^R \mid x \in (0,1)^+, y \in (0,1)^*\}$ is regular.
(ii) There exists a language that is recursively enumerable but Not REC.
Which of the following is correct?
(a) Only (i) is correct
(b) Only (ii) is correct
(c) Both (i) & (ii) are correct
(d) None of these

7. [MCQ]
Which of the following is Turing acceptable?
(a) Set of real numbers.
(b) Set of real number between 0 and 1
(c) Set of prime numbers
(d) All of the above.

8. [MSQ]

Which of the following are equivalent to Turing Machine?

(a) Universal Turing Machine.
(b) Multi-stack PDA
(c) Finite Automata with two Stack
(d) Finite Automata with read/write tape and bidirectional head.

9. [NAT]

How many statements are correct from the following?

(i) If TM head is unidirectional then language accepted by TM is regular.
(ii) If TM always halts then L(TM) is recursive language.
(iii) If TM always halt and uses linear bound tape then L(TM) is recursively enumerable.

10. [MCQ]

Which of the following is false?

(a) Union of two recursive language is recursive.
(b) Intersection of regular and recursive language is recursive.
(c) Union of regular and recursive is recursive.
(d) None of these.

Answer Key

1. (c)
2. (b)
3. (b)
4. (a, b, c)
5. (7)
6. (c)
7. (c)
8. (a, b, c, d)
9. (2)
10. (d)

Hint & Solutions

1. (c)

Given:

$L_1 = a^n\, b^n\, c^*$

$L_2 = a^* b^n\, c^n$

$L_1 \cap L_2 = a^n\, b^n\, c^n$

$L = a^n\, b^n\, c^n$, this is CSL but not CFL.

$\therefore$ Option 'C' is correct.

2. (b)

(a) CFL $\cap$ DFCL = may or may not be CFL. [so false]

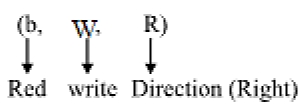
(b) CFL $\cap$ CFL = need not to be CFL. [so true]

(c) Set of all CFL's $\cap$ set of all regular's = set of all regular [So, false]

(d) CFL $\cap$ infinte langauge = Need not to be CFL. [So false]

3. (b)

Read b, write W and more to right direction.



4. (a,b,c)

(a) Turing machine always halt for valid strings.

(b) Turing machine may halt for invalid strings.

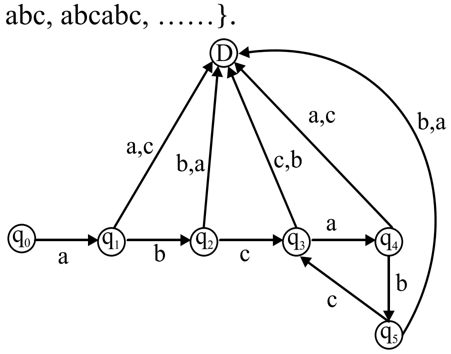
(c) Turing machine accepts recursively enumerable language.

(d) Halting Turing machine accepts recursively enumerable language, HTM accepts recursive language.

5. (7)

The minimal DFA for the above grammar is as follows:

The language generated by given grammar is Lz {$\in$, abc, abcabc, ……}.



Total 7, states are required.

6. (c)

(i) $L_1 = \{xyx^R \mid x \in (0,1)^+,\ y \in (0,1)^*\}$ is regular.

(ii) There exists a language that is recursively enumerable but Not REC.

Both statements are correct. So option C is correct.

7. (c)

Set of real number between 0 and 1 are uncountable and not turing are acceptable.

Set of prime number are decidable and acceptable by turing machine.

8. (a, b, c, d)

(a) Universal Turing Machine.

(b) Multi-stack PDA

(c) Finite Automata with two Stack

(d) Finite Automata with read/write tape and bidirectional head.

(a), (b), (c), (d) all are equivalent to Turing machine.

9. (2)

(i) If TM head is unidirectional then language accepted by TM is regular.

(ii) If TM always halts then L(TM) is recursive language.

Only these 2 statements are true.

If TM always halts and uses linear bound tape then L(TM) is CSL. So, (iii) is false.

10. (d)

Recursive $\cup$ Recursive = Recursive

Regular $\cap$ Recursive = Recursive

Regular $\cup$ Recursive = Recursive

$\therefore$ D is correct.