

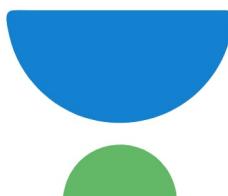


Programming-C & Theory of Computation

Workbook

Computer Science Engineering
Information Technology

GATE



unacademy

Programming-C & Theory of Computation

Workbook

Computer Science Engineering

Information Technology

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Edition : PC&TOC-2024/2025

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GATE Syllabus

Programming-C :

1. Programming-C
2. Recursion

Theory of Computation :

Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context-free languages, pumping lemma. Turing machines and undecidability.

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Theory of Computation :

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Programming-C



Classroom Questions

Q.1 Consider the following program. What will be the output?

```
#include<stdio.h>
void main()
{
    char ch=130;
    printf("%d",ch);
}
```

- (A) 130 (B) 2 (C) 255 (D) – 126

Q.2 Consider the following program. What will be the output?

```
#include<stdio.h>
void main()
{
    int a=3.0*4%2-3/2.0;
    printf("%d",a);
}
```

- (A) 1 (B) 1.00000 (C) Compilation Error (D) None of these

Q.3 Consider the following program.

```
#include<stdio.h>
void main()
{
    int a;
    a=3>2<1>4<6==0;
    printf("%d",a);
}
```

The output is _____

Q.4 Consider the following program.

```
#include<stdio.h>
void main()
{
    int a;
    a=30>20>0!=2<50>40!=50;
    printf("%d",a);
}
```

The output is _____

Q.5 Consider the following program.

```
#include<stdio.h>
void main()
```



```
{  
    int x;  
    x=40;  
    printf("%d%d%d",x!=100,x==100,x==60);  
}
```

The output is _____

Q.6 Consider the following program.

```
#include<stdio.h>  
void main()  
{  
    int x=12,y=1,z;  
    z=y || ++x;  
    printf("%d%d%d",x,y,z);  
}
```

The output is _____

Q.7 #include<stdio.h>

```
void main()  
{  
    int a=1,b=-1,c=0,d;  
    d--a || ++b && c++;  
    printf("%d%d%d%d",a,b,c,d);  
}
```

The output is _____

Q.8 Consider the following program.

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

The output is _____

Q.9 What will be the output of the C program?

```
#include<stdio.h>  
int main()  
{  
    int a = 2, b = 2, c = 0, d = 2, m;  
    m = a++ && b++ && c++ || d++;  
    printf("%d %d %d %d %d",a, b, c, d, m);  
    return 0;  
}
```

(A) Compilation error

(B) 3 3 1 3 1

(C) 3 3 1 3 0

(D) some garbage value

Q.10 Consider the following program. What will be the output?

```
#include<stdio.h>
void main()
{
    int a;
    a= 10!=12>50? !4!=4?8>8!=0?10:20:30:40;
    printf("%d",a);
}
```

- (A) 10 (B) 20 (C) 30 (D) 40

Q.11 Consider the following program. What will be the output?

```
#include<stdio.h>
void main()
{
    int a;
    a= 2 > 5 ? 1!=2>5?10:20:5<8?2!=2>5?!5?30:!1!=1?40:50:60:70;
    printf("%d",a);
}
```

- (A) 40 (B) 50 (C) 60 (D) None of these

Q.12 Consider the following program.

```
#include<stdio.h>
void main()
{
    int a;
    a= 120 > 50 ? printf("GATE") && printf("CSE")||printf("pankaj"):printf("neeraj");
    printf("%d",a);
}
```

The output is_____

Q.13 Consider the following program. What will be the output?

```
#include<stdio.h>
void main()
{
    int a=10 + 01 + 0x10;
    printf("%d",a);
}
```

- (A) Compilation Error (B) 27
 (C) 26 (D) 10

Q.14 Consider the following program. What will be the output?

```
#include<stdio.h>
void main()
{
    int a=10 + 01 + 0XAc ;
    printf("%d",a);
}
```

- (A) 183 (B) 34 (C) Compilation Error (D) None of these

Q.15 Consider the following program. What will be the output?

```
#include<stdio.h>
void main()
```

```
    printf("%d ",a);
    printf("%o ",a);
    printf("%x ",a);
}
```

The output is_____

Q.16 What will be the output of the C program?

```
#include<stdio.h>
int main()
{
    char num = '\010';
    printf("%d", num);
    return 0;
}
```

- (A) 010 (B) 08 (C) 10 (D) 8

Q.17 Consider the following program. What will be the output?

```
#include<stdio.h>
int main()
{
    void x=10;
    printf("%v", x);
    return 0;
}
```

- (A) Compilation error (B) 10
(C) Garbage value (D) 0

Q.18 Consider the following program.

```
#include<stdio.h>
void main()
{
    int a=sizeof(char)>-12 ;
    printf("%d",a);
}
```

The output is _____

Q.19 What will be the output of the C program?

```
#include<stdio.h>
int main()
{
    int num = 8;
    printf ("%d %d", num << 1, num >> 1);
    return 0;
}
```

- (A) 7 9 (B) 4 16 (C) 9 7 (D) 16 4



Q.20 What will be the output of the C program?

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

```
{  
    unsigned int num = -40;  
    printf("%d", ~num);  
    return 0;  
}  
  
(A) Compilation error  
(B) 39  
(C) 40  
(D) some garbage value
```

Q.21 What will be the output of the C program?

```
#include<stdio.h>
int main()
{
    int x = 2;
    (x & 1) ? printf("GATE") : printf("ACADEMY");
    return 0;
```


Q.22 Consider the following C program

GATE 2017

```
# include <stdio.h>
int main () {
    int m = 10;
    int n, n1;
    n = ++m;
    n1 = m++;
    n -=;
    --n1;
    n -= n1;
    printf("%d", n);
    return 0; }
```

The output of the program is _____.

Q.23 What does the following code do?

GATE 1993

```
var a, b : integer;  
begin  
    a := a + b;  
    b := a - b;  
    a := a - b;  
end.
```



Q.24 Suppose n and p are unsigned int variable in a C program. We wish to set p to nC_3 . If n is large, which one of the following statements is most likely to set p correctly?

GATE 2014

- (A) $p = n * (n - 1) * (n - 2) / 6;$ (B) $p = n * (n - 1) / 2 * (n - 2) / 3;$
 (C) $p = n * (n - 1) / 3 * (n - 2) / 2;$ (D) $p = n * (n - 1) / 2 * (n - 2) / 6.$

Q.5 Consider the following program. What will be the output.

```
#include<stdio.h>
void main()
{
    int a;
    a=20>100?100: !12!=3>50 ? 300 : 400 ;
    printf("%d",a);
}
```

- (A) 100 (B) 300 (C) 400 (D) None of these

Q.6 Consider the following program.

```
#include<stdio.h>
void main()
{
    int a;
    a= 120 > 50 ? printf("%d",printf("pankaj")):printf("neeraj");
    printf("%d",a);
}
```

The output is _____

Q.7 Consider the following program. What will be the output?

```
#include <stdio.h>
int main()
{
    int x;
    x = 2 > 5 != 1 ? 5 < 8 && 8 > 2 ? !5 ? 10 : 20 : 30 : 40;
    printf("Value of x:%d", x);
    return 0;
}
```

Q.8 What is the output of the following code ?

```
#include<stdio.h>
int main(){
    int num = - -10;
    printf("%d", num);
    return 0;
}
```

- (A) Runtime error (B) Compilation error (C) -10 (D) 10

Programming-C

7



Q.9 What will be the output of the C program?

```
#include<stdio.h>
int main()
{
    int a = 1, b = 3, c;
    c = b << a;
    b = c * (b * (++a)--);
```

```
a = a >> b;  
printf("%d",b);  
return 0;  
}  
(A) 36                   (B) Compilation error   (C) 30                   (D) 24
```

Q.10 Assuming integer is of 4 bytes ,the output of the following code :

```
#include<stdio.h>
void main()
{
    printf("%d",-1>>1);
    printf("%d",0<<1);
```

is

Q.11 Consider the following program.

```
#include <stdio.h>
int main()
{
    printf("%d",1<<2+3<<4);
    return 0;
```

The output is

Q.12 Consider the following program. What will be the output?

```
#include <stdio.h>
int main()
{
    char var=0x04;
    var = var | 0x04;
    printf("%d,",var);
    var |= 0x01;
    printf("%d",var);
    return 0;
}
```

(A) 8, 9 (B) 4, 5 (C) 8, 8 (D) 4, 4

O.13 Which statement is suitable to check 2nd (count from 0) bit is high (set) or not?

(A) (num & $1 \ll 2$) (B) (num & 0x04) (C) (num & 0x03) (D) Both (1) and (2)

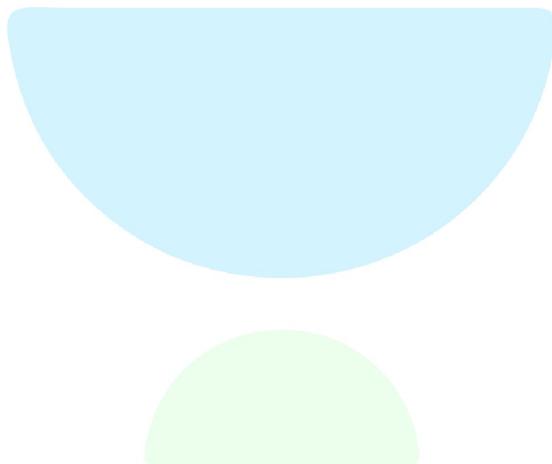


Answer Key

Classroom Practice Questions									
1	D	2	C	3	0	4	1	5	0 100 0
6	12 1 1	7	0 0 0 0	8	0 0 1 0	9	B	10	B
11	A	12	GATECSE1	13	B	14	A	15	10 12 a
16	D	17	A	18	0	19	D	20	B
21	C	22	0	23	A	24	B	25	A

Self-Practice Questions									
1	D	2	1	3	5 5 6 1	4	5 6 6 7 1	5	C
6	pankaj61	7	Value of x : 20	8	D	9	B	10	- 10
11	512	12	B	13	D				

□□□



2

Flow Control Statements



Classroom Questions

- Q.1** Consider the following function

```
double f (double x)
{
    if (abs (x*x-3) <0.01) return x;
}
```

GATE 2014

```
    ...  
    else return f (x/2+1.5/x);  
}
```

Give a value q (to 2 decimals) such that f (q) will return q: _____

Q.2 Consider the following program.

```
#include<stdio.h>  
void main()  
{  
    int a=10,b=20,c=30,d=2;  
    if(a<b>c<10>=2+d)  
        printf("pankaj");  
    else  
        printf("neeraj");  
}
```

The output is _____

Q.3 Consider the following program.

```
#include<stdio.h>  
void main()  
{  
    int a=10,b=20,c=30,d=2;  
    if(a<10<b>c<10>=1)  
        printf("pankaj");  
    else  
        printf("neeraj");  
}
```

The output is _____

Q.4 Predict the output of the below program:

```
#include <stdio.h>  
#define ONE 0  
#define ZERO 1  
int main()  
{  
    int i = 3;  
    switch (i & 1)  
    {  
        case ONE: printf("Even");  
        break;  
        case ZERO: printf("Odd");  
        break;  
    }
```



```
    default: printf("Default");  
}  
return 0;  
}
```

Q.5 Output of following C program?

```
#include<stdio.h>  
int main()  
{  
    int i = 0;  
    for (printf("Pankaj\t"); i < 2 && printf("Hello\t"); ++i && printf("Hi\t"))  
    {  
        printf("OO\t");  
    }
```

```
    }  
    return 0;  
}
```

Q.6 What will be the output of the C program?

```
#include<stdio.h>  
int main()  
{  
    int i = 4, j = 5, k = 6;  
    if(i > j == k)  
        printf("%d %d %d", i++, ++j, --k);  
    else  
        printf("%d %d %d", i, j, k);  
    return 0;  
}
```

(A) 4 6 5

(B) 4 5 6

(C) 5 5 5

(D) 4 6 6

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

```
#include<stdio.h>  
int main()  
{  
    int i;  
    if(scanf("%d",&i)) //if we give input as 0  
        printf("Pankaj");  
    else  
        printf("Sharma");  
    return 0;  
}
```

(A) Runtime Error (B) Compilation Error (C) Pankaj

(D) Sharma

Q.8 Consider the following program. What will be the output?

```
#include<stdio.h>  
void main()  
{  
    if(0xB)  
    if(012)  
    if('\x12')  
    if('\012')
```


printf("Pankaj Sharma");
else;
else;
else;
else;

}

(A) Pankaj Sharma

(B) Compilation error: Misplaced else

(C) Compilation error: If without any body

(D) Compilation error: Undefined symbol

Q.9 Consider the following C code. Assume that unsigned long int type length is 64 bits.

```
unsigned long int fun (unsigned long int n)
```

{

```
    unsigned long int i, j = 0, sum = 0;
```



```
while (r >= y)
{
    r = r - y
    q = q + 1
}
```

Which of the following conditions on the variables x, y, q and r before the execution of the fragment will ensure that the loop terminates in a state satisfying the condition $x = (y * q + r)$?

- (A) $(q == r) \&\& (r == 0)$ (B) $(x > 0) \&\& (r == x) \&\& (y > 0)$
(C) $(q == 0) \&\& (r == x) \&\& (y > 0)$ (D) $(q == 0) \&\& (y > 0)$

Q.15 The following function computes X^Y for positive integer X and Y. integers X and Y.

```
int exp (int X, int Y)
{
    int res = 1, a = X, b = Y;
    while (b != 0)
    {
        if (b% 2 == 0)
        {
            a = a*a;
            b = b/2;
        }
        else
        {
            res = res*a;
            b = b -1;
        }
    }
    return res;
}
```



Which one of the following conditions is TRUE before every iteration of the loop?

Q.16 What will be the output of following code?

```
#include<stdio.h>
```

```
void main()
```

{

```
int i=0;  
for(++i; ++i; ++i)  
{  
    printf("%d ",i);  
    if(i==4) break;  
}
```

Q.17 Consider the following pseudo code, where x and y are positive integer.

```
begin
q := 0;
r := x;
while r ≥ y do
being r := r - y ;
q := q + 1 ; end
end
```

The post condition that needs to be satisfied after the program terminates is

GATE 2015

- (A){ $r = qx + y \wedge r < y$ } (B){ $x = qy + r \wedge r < y$ } (C){ $y = qx + r \wedge 0 < r < y$ } (D){ $q + 10$ }

Q.18 What will be the output of the following code?

```
#include<stdio.h>
void main()
{
    int x=1, y=1;
    for( ; y ; printf("%d %d",x,y))
    {
        y=x++ <=5;
    }
}
```

Q.19 Consider the following program fragment for reversing the digits in given integer to obtain a new integer. Let $n=d_1d_2\dots d_m$.

```
int n, rev ;
rev = 0;
while (n > 0)
{
    rev = rev * 10 + n % 10;
```

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Programming-C

$n = n /10;$

}

The loop invariant condition at the end of the i^{th} iteration is :

GATE 2004

- (A) $n = d_1d_2\dots d_{m-i}$ and $\text{rev} = d_m d_{m-i} \dots d_{m-i+1}$ (B) $n = d_{m-i+1} \dots d_{m-i} d_m$ or $\text{rev} = d_{m-1} \dots d_2 d_1$
(C) $n \neq \text{rev}$ (D) $n = d_1d_2\dots d_m$ and $\text{rev} = d_m \dots d_2 d_1$

Q.20 What will be the output of the C program?

```
#include<stdio.h>
int main()
{
    int i = 1, j = 1;
    for(;j;printf("%d %d ",i, j))
    {
        j = i++ <= 1;
    }
    return 0;
}
```

Q.21 Let A be a square matrix of size $n \times n$. Consider the following pseudocode. What is the expected output?

GATE 2014

```
C =100;  
for i = 1 to n do  
for j = 1 to n do  
{  
    temp = A [i][j] +C;  
    A[i][j] = A[j][i];  
    A[j][i] = temp - C;  
}  
for i = 1 to n do  
for j =1 to n do  
output (A [i][j]);
```

- (A) The matrix A itself
- (B) Transpose of the matrix A
- (C) Adding 100 to the upper diagonal elements and subtracting 100 from lower diagonal elements of A
- (D) None of the above

Q.22 The output of the following code:

```
#include<stdio.h>  
int main()  
{  
    int i = 1, j = 1;  
    for(--i && j++ ; i<10; i+=2)  
    {  
        printf("loop ");  
    }
```

Programming-C

15

return 0;
}
is _____

Q.23 What will be output when you will execute following c code?

```
#include<stdio.h>  
void main()  
{  
    int a=10;  
    if(printf("%d",a>=6)-6)  
    for();  
        break;  
    else;  
}
```

- (A) It will print nothing
- (B) 1
- (C) Compilation error: Misplaced else
- (D) Infinite loop

Q.24 A typical “switch” body looks as follows:

```
switch (controlling_expression)  
{
```

```

case label1:
/*label1 statements*/
    break;
case label2:
/*label2 statements*/
    break;
default:
/*Default statements*/
}

```

Which of the following statement is not correct statement?

- (A) "switch" body may not have any "case" label at all and it would still compile.
- (B) "switch" body may not have the "default" label and it would still compile.
- (C) "switch" body may contain more than one "case" labels where the label value of these "case" is same and it would still compile. If "switch" controlling expression results in this "case" label value, the "case" which is placed first would be executed.
- (D) "switch" body may not have any "break" statement and it would still compile.
- (E) "switch" body can have the "default" label at first i.e. before all the other "case" labels. It would still compile.

Q.25 What will be output when you will execute following c code?

```

#include<stdio.h>
void main()
{
    int movie=1;
    switch(movie<<2+movie)
    {
        default:printf("hey bhagwan");
        case 4: printf(" bachale");
        case 5: printf(" C programming ");
    }
}

```

```

        case 8: printf(" Se");
    }
}

```

Practice Questions

Q.1 What will be the output for inputs n=64 and n=23 respectively ?

```

#include<stdio.h>
int main()
{
    printf("enter the number");
    scanf("%d",&n);
    if(n & (n-1))
        printf("Mahol bana dia guru\n");
    else
        printf("Koi ni agli bar bana denge");
}

```

- (A) Mahol bana dia guru Koi ni agli bar bana denge
- (B) Koi ni agli bar bana denge Mahol bana dia guru
- (C) Mahol bana dia guru Mahol bana dia guru

(D) Koi ni agli bar bana denge Koi ni agli bar bana denge

Q.2 What will be output when you will execute following c code?

```
#include<stdio.h>
void main()
{
    int a=5,b=10,c=1;
    if(a&&b>c)
    {
        printf("Pankaj");
    }
    else
    {
        break;
    }
}
```

(A) Pankaj

(B) It will print nothing

(C) Run time error

(D) Compilation error

Q.3 What will be output when you will execute following c code?

```
#include<stdio.h>
void main()
{
    int a=5,b=10;
    if(a<++a||b<++b)
        printf("%d %d",a,b);
    else
```

printf("Pankaj Sharma");

}

(A) 5 10

(B) 6 11

(C) 6 10

(D) Pankaj Sharma

Q.4 What will be output when you will execute following c code?

```
#include<stdio.h>
void main()
{
    int x=1,y=2;
    if(--x && --y)
        printf("x=%d y=%d",x,y);
    else
        printf("%d %d",x,y);
}
```

(A) 1 2

(B) x=1 y=2

(C) 0 2

(D) x=0 y=1

Q.5 What will be output when you will execute following c code?

```
#include<stdio.h>
void main()
{
    int a=3;
```

```
if(a--,--a,a--,a)
    printf("Pankaj");
else
    printf("Sharma");
}
```

(A) Pankaj (B) Sharma (C) Run time error (D) Compilation
error

How many times printf statement will execute from Q6 to Q9 (n>=1)

Q.6 for(int i=n; i>=1; i=i/2)

```
    printf("pankaj");
```

Q.7 for(int i= 1; i<=n; i=i*3)

```
    printf("GATE ACADEMY");
```

Q.8 for(int i=1; i<=n;)

```
    printf("pankaj");
```

Q.9 for(int i=n; i>=1; i=i/3)

```
    printf("GATE ACADEMY");
```

Q.10 Consider the following program. What will be the output?

```
#include<stdio.h>
```

```
int main()
```

```
{
```

```
    int i,sum=0;
```

```
    for(i=1;i<=3;i++)
```

```
{
```

Programming-C

```
{
```

```
    int p=10;
```

```
    sum=sum+p;
```

```
}
```

```
    printf("%d",p);
```

```
    return 0;
```

```
}
```

(A)Compilation Error (B) 30

(C) 10

(D) None

Q.11 The output of the code :

```
#include<stdio.h>
```

```
int main()
```

```
{
```

```
    int i;
```

```
    for(i=0;i<6;i++)
```

```
{
```

```
        int a=20;
```

```
        printf("%d",a);
```

```
        a++;
```

```
}
```

```
    return 0;
```

```
}
```

,
is _____

Q.12 The number of times pankaj will be printed by the following code :

```
#include<stdio.h>
void main()
{
    int I, J, n ;
    for ( I=1 ; I<=n ;I++ )
        for ( J=1 ; J<=I ; J++)
            printf("pankaj");
}
```

is_____

Q.13 What will be output when you will execute following c code?

```
#include<stdio.h>
void main()
{
    switch(5|2|1)
    {
        case 3&2: printf("Pankaj Sharma");
        break;
        case -~11: printf("GATE");
        break;
        case 6-3<<2: printf("ACADEMY");
    }
}
```

```
break;
case 5>=5: printf("First year");
}
}
```

Q.14 What will be output when you will execute following c code?

```
#include<stdio.h>
void main()
{
    int a=3,b=2;
    a=a==b==0;
    switch(1)
    {
        a=a+10;
    }
    sizeof(a++);
    printf("%d",a);
}
```

Q.15 Consider the following program.

```
int main()
{
    int i;
    printf("enter any number");
```

```

scanf("%d",&i);
switch(i)
{
    default : printf("Neeraj");
    case 2 ... 10 : printf("GLA");
    case 1+2*3 : printf("CSE");
    break;
    case 1||2 : printf("pankaj");
    break;
    case 10.2 : printf("float");
}
return 0;
}

```

Assume input is 10. The output is _____.

20

Programming-C

Answer Key

Classroom Practice Questions									
1	1.73	2	neeraj	3	pankaj	4	Odd	5	*
6	B	7	C	8	A	9	B	10	10n
11	n^2	12	$\log_2 n + 1$	13	B	14	C	15	C
16	2 4	17	B	18	*	19	A	20	2 1 3 0
21	A	22	*	23	B	24	C	25	Se
Self-Practice Questions									
1	B	2	D	3	D	4	C	5	B
6	$\log_2 n + 1$	7	$\log_3 n + 1$	8	infinite times	9	$\log_3 n + 1$	10	A
11	*	12	$(n*(n+1))/2$	13	Compilation Error	14	1	15	Compilation Error

Classroom Practice Questions

5 Pankaj Hello 00 Hi Hello 00 Hi

18 2 13 14 15 16 17 0

22 loop loop loop loop loop

Self-Practice Questions

11. 20 20 20 20 20 20

3**Function and Storage Class****Classroom Questions**

Q.1 Consider the following C program:

```
double foo (double);      /* Line 1 */
int main ()
{
    double da, db;
    // input da
    db = foo (da);
}
double foo (double a)
{
    return a;
}
```

The above code compiled without any error or warning. If Line 1 is deleted, the above code will show

GATE 2005

- (A) No compile warning or error
- (B) Some compiler-warnings not leading to unintended results
- (C) Some compiler-warnings due to type mismatch eventually leading to unintended

results

(D) Compiler errors

Q.2 Which of the following is/are true regarding register variable :

(A) A register variable execute faster than other variables.

(B) Default initial value of register variable is garbage.

(C) Scope and visibility of register variable is block.

(D) The register modifier tells the compiler to do its best to keep the variable in a register if at all possible. Otherwise it is stored on the stack.

(E) All of these

Q.3 Which of the following is/are true regarding static variable :

(A) static variables are stored in a data segment.

(B) static variables have visibility from the point of declaration to the end of the enclosing scope.

(C) A same static variable can be declared many times but we can initialize it only one time.

(D) We cannot write any assignment statement globally.

(E) All of these

Q.4 Which of the following is/are true regarding static variable:

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Programming-C



(A) A static variable initializes only one time in whole program.

(B) If we declared static variable locally then its visibility will within a block where it has declared.

(C) If declared a static variable or function globally then its visibility will only the file in which it has declared not in the other files.

(D) A static variable has internal linkage.

(E) All of these

Q.5 Where is static variable and auto variables stored respectively ?

(A) uninitialized data segment, stack

(B) initialized data segment, stack

(C) data segment ,stack

(D) heap ,stack

Q.6 Consider the following program

```
#include <stdio.h>
int main()
{
    int x = 1;
    static int y = x;
    y++;
    x++;
    printf("%d%d",x,y);
    return 0;
}
```

(A) 2 2

(B) 1 2

(C) 2 1

(D) Compilation

Error

Q.7 The value of j at the end of the execution of the following C program. **GATE 2000**

```
int incr (int i)
```

.

```
    static int count = 0;  
    count = count + i;  
    return (count);  
}
```

```
main ()  
{
```

```
    int i,j;  
    for (i = 0; i <=4; i++)  
        j = incr(i);
```

```
}
```

(A) 10 (B) 4

(C) 6

(D) 7

Q.8 Consider the following program:

```
#include<stdio.h>  
void f1()  
{  
    static int my_x=1;  
    my_x++;
```

Programming-C

23

```
    printf("%d",my_X);  
}  
void f2()  
{  
    static int my_x=10;  
    my_x++;  
    printf("%d",my_X);  
}  
int main()  
{  
    f1();  
    f2();  
    f1();  
    f2();  
    return 0;  
}
```

The output of the above program is____?

(A) Compilation Error

(B) Runtime error

(C) 2 11 3 12

(D) 1 10 2 11

Q.9 Consider the following C functions:

```
int f(int n )  
{  
    static int i = 1;  
    if (n > = 5) return n ;  
    n = n + i ;  
    i++;  
    return f (n) ;  
}
```

The value returned by f(1) is

GATE 2004

(A) 5

(B) 6

(C) 7

(D) 8

Q.10 What is the output of the following program?

```
#include<stdio.h>
int funcf (int x);
int funcg (int y);
main ()
{
    int x=5, y=10, count;
    for (count = 1; count <=2; ++count)
    {
        y += funcf (x) + funcg (x);
        printf ("%d", y) ;
    }
}
funcf (int x)
{
    int y;
```

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Programming-C



```
y = funcg(x);
return (y);
}
funcg (int x)
{
    static int y = 10;
    y + 1= 1;
    return (y + x);
}
```

(A) 43 80

(B) 42 74

(C) 33 37

(D) 32 32

Q.11 Consider the following C program

```
int a, b, c = 0;
void prtFun (void);
int main ()
{
    static int a = 1; /* line 1 */
    prtFun();
    a += 1;
    prtFun();
    printf ("\n %d %d ", a, b) ;
}
void prtFun (void)
{
    static int a = 2; /* line 2 */
    int b = 1;
    a += ++b;
    printf (" \n %d %d ", a, b);
}
```

What output will be generated by the given code segment?

GATE 2012

3 1
(A) 4 1
4 2

4 2
(B) 6 1
6 1

4 2
(C) 6 2
2 0

3 1
(D) 5 2
5 2

Q.12 What output will be generated by the given code segment if:

Line 1 is replaced by “auto int a = 1”;

Line 2 is replaced by “register int a = 2” in previous question ?

3 1
(A) 4 1
4 2

4 2
(B) 6 1
6 1

4 2
(C) 6 2
2 0

4 2
(D) 4 2
2 0

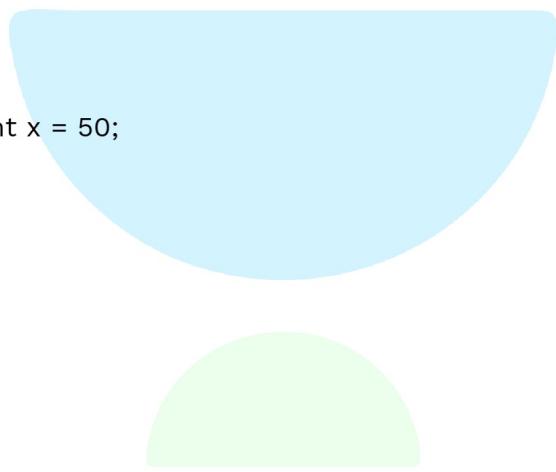
Q.13 Consider the following C program.

GATE 2015

```
# include <stdio.h>
int f1(void);
int f2(void);
```

Programming-C

25



```
int f3(void);
int x = 10;
int main()
{
    int x = 1;
    x += f1() + f2() + f3() + f2();
    printf("%d", x);
    return 0;
}
int f1()
{
    int x = 25;
    x++;
    return x;
}
int f2( )
{
    static int x = 50;
    x++;
    return x;
}
int f3( )
{
    x *= 10;
    return x;
}
```

The output of the program is _____.

Q.14 Consider the following C program:

```
#include <stdio.h>
int r()
{
    static int num =7;
    return num--;
}
int main ( )
{
    for (r( );r( );r( ));
    printf ("%d",r( ));
    return 0;
}
```

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Programming-C



Which one of the following values will be displayed on execution of the programs?

GATE 2019

- (A) 41 (B) 52 (C) 63 (D) 630

Q.15 What will be the output of the following program ?

```
int main()
{
    int y;
    static char x='A';
    x++;
    y=++x;
    printf("%d %d",x,y);
    return 0;
}
```

- (A) Garbage 67 (B) 67 Garbage (C) 67 67 (D) None

Q.16 What will be the output of the C program?

```
#include<stdio.h>
static int i=2;
extern int i;
int main()
{
    printf("%d",i);
    return 0;
}
```

- (A) 0 (B) 2 (C) Compilation Error (D) Runtime Error

Q.17 Find the output of the following code :

```
#include<stdio.h>
void Fun(int);
int main()
{
    Fun(3);
    return 0;
}
```

```
}
```

```
void Fun(int n)
```

```
{
```

```
    if(n>0)
```

```
    {
```

```
        Fun(n-1);
```

```
        printf("%d ",n);
```

```
        Fun(n-1) ;
```

```
}
```

```
}
```

(A)1211213

(B) 121

(C) 1213121

(D) 121121



Q.18 Find the output of the following code

```
#include<stdio.h>
```

```
int Fun(int);
```

```
int main()
```

```
{
```

```
    printf("%d",Fun(6));
```

```
    return 0;
```

```
}
```

```
int Fun(int n)
```

```
{
```

```
    if(n<=1)
```

```
    return n;
```

```
    return Fun(n/2) + Fun(n/2) +1;
```

```
}
```

(A) 3

(B) 6

(C) 7

(D) 4

Q.19 Find the output of the following code

```
#include<stdio.h>
```

```
int Fun(int);
```

```
int main()
```

```
{
```

```
    printf("%d",Fun(6));
```

```
    return 0;
```

```
}
```

```
int Fun(int n)
```

```
{
```

```
    if(n<=1)
```

```
    return n;
```

```
    return 2* Fun(n/2) +1;
```

```
}
```

(A)3

(B) 6

(C) 7

(D) 4

Q.20 Find the output of the following code

```
#include<stdio.h>
int Fun(int);
int main()
{
    printf("%d",Fun(12));
    return 0;
}
int Fun(int n)
{
    if(n<=1)
        return n;
```

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Programming-C

```
    return Fun(n/2) +n/2;
}
```

(A) 13 (B) 12 (C) 7 (D) 11

Q.21 Consider the following recursive C function that takes two arguments unsigned int foo(unsigned int n, unsigned int r)

```
{
    if (n > 0)
        return (n%r + foo (n/r, r ));
    else
        return 0;
}
```

What is the return value of the function foo when it is called as foo(345, 10) ?

GATE -2011

(A) 345 (B) 12 (C) 5 (D) 3

Q.22 Find the output of the following code :

```
#include<stdio.h>
void Fun(int);
int main()
{
    Fun(3);
    return 0;
}
void Fun(int n)
{
    if(n>0)
    {
        printf("%d",n);
        Fun(n-1);
        printf("%d",n);
    }
}
```

(A) 332211 (B) 321321 (C) 321123 (D) None of these

Q.23 What will be the output of the following program ?

```
int main()
{
```

```
f();f();  
}  
f()  
{  
    static int x;  
    printf("%d", ++x);  
}  
(A) 0 1  
(B) 1 2  
(C) Garbage  
(D) None
```

Q.24 Consider the following C function.

```
int fun(int x)
```



```
{  
    if(x>3)  
        return fun(x-4) + fun(x-1) + 1;  
    return 1;  
}
```

The value returned by `fun(12)` is_____

Q.25 Consider the following C function.

```
int fun (int n)  
{  
    int x=1, k;  
    if (n==1) return x;  
    for (k=1; k<n; ++k)  
        x = x + fun(k) * fun(n - k);  
    return x;  
}
```

The return value of `fun(5)` is _____.

- (A) 0
(B) 26
(C) 51
(D) 71

Q.26 Consider the following C function, what is the output?

GATE 2007

```
#include <stdio.h>  
int f(int n)  
{  
    static int r = 0;  
    if (n <= 0) return 1;  
    if (n > 3)  
    {  
        r = n;  
        return f(n-2)+2;  
    }  
    return f(n-1)+r;  
}  
int main()  
{  
    printf("%d", f(5));  
}
```

(A)

5 (B)

7 (C)

9 (D) 18

- Q.27** The following function computes the value of ${}^m C_n$ correctly for all legal values m and n
($m \geq 1, n \geq 0$ and $m > n$)

GATE 2006

```
int func(int m, int n)
{
    if (E) return 1;
    else
        return(func(m - 1, n) + func(m - 1, n - 1));
```

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Programming-C

}

In the above function, which of the following is the correct expression for E?

(A) ($n == 0$) || ($m == 1$)(B) ($n == 0$) && ($m == 1$)(C) ($n == 0$) || ($m == n$)(D) ($n == 0$) && ($m ==$

n)

- Q.28** What is the output printed by the following program?

GATE 2005

```
#include <stdio.h>
int f(int n, int k)
{
    if (n == 0) return 0;
    else if (n% 2) return f(n/2, 2*k)+k;
    else return f (n/2, 2*k)-k;
}
int main ( )
{
    printf ("%d", f(20, 1));
    return 0;
}
```

(A) 5

(B) 8

(C) 9

(D) 20

- Q.29** Consider the C function given below

```
int f(int j)
{
    static int i = 50;
    int k;
    if (i == j)
    {
        printf("something")
        k = f(i);
        return 0;
    }
    else return 0;
}
```

Which one of the following is TRUE?

GATE 2014

(A) The function returns 0 for all values of j.

(B) The function prints the string "something" for all values of j.

(C) The function returns 0 when i = 50.

(D) The function will exhaust the runtime stack or run into an infinite loop when $j = 50$.

Q.30 Consider the following two functions :

```
void fun1 (int n)
{
    if (n == 0) return;
    printf ("%d", n);
```

```
        fun2 (n -2);
        printf ("% d" , n);
    }
void fun2 (int n)
{
    if ( n == 0) return;
    printf("%d" , n);
    fun1 (++ n);
    printf ("%d", n);
}
```

The output printed when $\text{fun1}(5)$ is called is

GATE 2017

- (A) 53423122233445 (B) 53423120112233
(C) 53423122132435 (D) 53423120213243

Q.31 Consider the following C functions.

GATE 2020

```
int fun1 (int n)
{
    static int i=0;
    if (n > 0)
    {
        + + i;
        fun1 (n-1);
    }
    return (i);
}
int fun2 (int n)
{
    static int i=0;
    if (n > 0)
    {
        i=i+fun1 (n);
        fun2 (n-1);
    }
    return (i);
}
```

The return value of fun2(5) is _____ .

Q.32 What will be the output of the following C program?

GATE 2016

```
void count (int n)
{
    static int d = 1;
    printf("%d", n);
```

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Programming-C



```
printf("%d", d);
d++;
if (n > 1) count (n-1);
print f("%d", d);
}
void main ( )
{
    count (3);
}
```

(A) 3 1 2 2 1 3 4 4 4 (B) 3 1 2 1 1 1 2 2 2 (C) 3 1 2 2 1 3 4 (D) 3 1 2 1 1 1 2

Q.33 Consider the following recursive C function.

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

If get (6) function is being called in main () then how many times will the get() function be invoked before returning to the main ()?

GATE 2015

- (A) 15 (B) 25 (C) 35 (D) 45

Q.34 What will be the output of the C program?

```
#include<stdio.h>
void fun(int);
int main()
{
    int a = 3;
    fun(a);
    return 0;
}
void fun(int n)
{
    if (n > 0)
    {
        fun(--n);
        printf("%d ", n);
    }
}
```

- (A) 1 2 3 (B) No Output (C) 0 1 2 (D) 0

Q.35 Consider the following recursive C function that takes two arguments

unsigned int foo(unsigned int n, unsigned int r)

```
{  
    if (n > 0)  
        return (n%r+foo (n/r, r ));  
    else  
        return 0;
```

```
}
```

What is the return value of the function foo when it is called as foo(513, 2)?

- (A) 9 (B) 8 (C) 5 (D) 2

GATE 2011

Q.36 The function f is defined as follows :

```
int f(int n)  
{  
    if (n <= 1)  
        return 1;  
    else if (n % 2 == 0)  
        return f(n/2);  
    else return f(3n - 1);  
}
```

Assuming that arbitrarily large integers can be passed as a parameter to the function, consider the following statements.

GATE 2007

- (i) The function f terminates for finitely many different values of $n \geq 1$.
- (ii) The function f terminates for infinitely many different values of $n \geq 1$.
- (iii) The function f does not terminate for finitely many different values of $n \geq 1$.
- (iv) The function f does not terminate for infinitely many different values of $n \geq 1$.

Which one of the following options is true of the above?

- (A) (i) and (iii) (B) (i) and (iv) (C) (ii) and (iii) (D) (ii) and (iv)

Q.37 Consider the following C program :

```
void foo(int n, int sum)  
{  
    int k = 0, j = 0;  
    if (n == 0) return;  
    k = n % 10; j = n / 10;  
    sum = sum + k;  
    foo (j, sum);  
    printf ("%d,", k);  
}  
  
int main ()  
{  
    int a = 2048, sum = 0;  
    foo (a, sum);  
    printf ("%d\n", sum);  
    getchar();  
}
```

What does the above program print?

- (A) 8, 4, 0, 2, 14 (B) 8, 4, 0, 2, 0 (C) 2, 0, 4, 8, 14 (D) 2, 0, 4, 8, 0

GATE 2005

Q.38 Consider the C functions foo and bar given below :

```
int foo (int val)  
{  
    int x = 0;  
    while (val > 0)
```

```
    while (val > 0)
    {
        x = x + foo (val - -);
    }
```

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Programming-C



```
    return val;
}
int bar (int val)
{
    int x = 0;
    while (val > 0)
    {
        x = x + bar (val - 1);
    }
    return val;
}
```

Invocations of foo (3) and bar (3) will result in :

GATE 2017

- (A) Return of 6 and 6 respectively.
- (B) Infinite loop and abnormal termination respectively.
- (C) Abnormal termination and infinite loop respectively.
- (D) Both terminating abnormally.

Practice Questions

Q.1 What will be the output of the C program?

```
#include<stdio.h>
```

```
int main()
{
    fun();
    return 0;
}
```

```
void fun()
```

```
{
    printf("Pankaj");
```

(A) Pankaj

(B) No output

(C) Runtime error

(D)

Compilation

error

Q.2 What will be the output of the C program?

```
#include<stdio.h>
```

```
int main()
{
    fun();
    return 0;
}
```

```
Int fun()
```

```
{
    printf("Pankaj");
```

(A) Pankaj

(B) No output

(C) Runtime error

(D)

Compilation

error

Q.3 What will be the output of the C program?

```
#include<stdio.h>
```



```
int main()
{
    int fun(int);
    int i = fun(10);
    printf("%d\n", --i);
    return 0;
}
int fun(int i)
{
    return (i++);
}
```

The output is_____

Q.4 What will be the output of the C program?

```
#include<stdio.h>
int fun(int);
int main()
{
    int k=35;
    k = fun(k=fun(k=fun(k)));
    printf("k=%d\n", k);
    return 0;
}
int fun(int k)
{
    k++;
    return k;
}
```

The output is_____

Q.5 What will be the output of the C program?

```
#include <stdio.h>
void display();
int main()
{
    void display();
    void display();
    display();
    return 0;
}
void display()
{
    printf("Pankaj ");
}
```

The output is :

(A) Pankaj

(B) Pankaj Pankaj Pankaj



(C) No output will be printed

(D) Compilation Error

Q.6 What will be the output of the C program?

```
#include <stdio.h>
int main()
{
    int x=20,y=10;
    swap(x,y);
    printf("%d %d",y,x+2);
    return 0;
}
swap(int x,int y)
{
    int temp;
    temp=x;
    x=y;
    y=temp;
}
```

The output is :

(A) 20 12

(B) 12 20

(C) Compilation Error

(D) None of these

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

```
#include<stdio.h>
int main()
{
    int x = 2;
    {
        int x = 4;
    }
    printf("%d",x);
    return 0;
}
```

(A) garbage value

(B) Compilation error

(C) 4

(D) 2

Q.8 Which of the following code segments may give an error

(A) #include<stdio.h>

```
int main()
```

```
{
```

```
    int x = 6;
```

```
    register int* a = &x ;
```

```
    printf("%d", *a);
```

```
    return 0;
```

```
}
```

(B) #include<stdio.h>

```
int main()
```

```
{
```

```
    register int x= 6;
```

```
    int* a = &x;
```



```

        printf("%d", *a);
        return 0;
    }
(C) #include<stdio.h>
int main()
{
    int x = 6;
    register static int* a = &x;
    printf("%d", *a);
    return 0;
}

```

(D) Both B and C

Q.9 Which of the following is true regarding register variables ?

- (A) Using & operator with register variable may raise an error.
- (B) The keyword register can be used with pointer variables.
- (C) The keyword static can not be used with register specifier.
- (D) All of these

Q.10 What will be the output of the C program?

```

#include<stdio.h>
int main()
{
    extern num;
    printf("%d",num);
    return 0;
}

```

int num = 36;

(A) 36

(B) Runtime error

(C) 0

(D) Compile time error

Q.11 Which of the following codes will create an error

(A)

```

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

```

(B)

```

#include<stdio.h>
static int a;
int main()
{
    printf("%d",a);
    return 0;
}

```

(C)

```

#include<stdio.h>
extern int a;

```



```
int main()
{
    printf("%d",a);
    return 0;
}
```

(D) None

Q.12 What will be the output of the C program?

```
#include <stdio.h>
static char c;
static int i;
static float f;
int main()
{
    printf("%d %d %f ",c,i,f);
    return 0;
}
```

The output is _____

(A) 0 0 0.000000 (B) 0 0 0 (C) Compilation Error (D) None

Q.13 Which of the following code will create an error

(A) #include <stdio.h>
static int i=12;
static int i;
static int i;
int main()
{
 static int i=14;
 printf("%d",i);
 return 0;
}

(B) #include <stdio.h>
static int i=32;
static int i;
int main()
{
 printf("%d",i);
 return 0;
}

(C) #include<stdio.h>
int main()
{
 int a=12;
 int a;
 int a;
 printf("%d",a);
 return 0;
}



}

- (D) Both B and C

Q.14 Which of the following will create an error

- (A)

```
#include <stdio.h>
static int i=2;
i=55;
int main()
{
```

```
    printf("%d",i);
    return 0;
}
```

- (B) #include <stdio.h>

```
static int i=2;
int main()
{
```

```
    i=55;
    printf("%d",i);
    return 0;
}
```

- (C) Both A and B

- (D) None of these

Q.15 Which of the following will create an error?

- (A) #include<stdio.h>

```
int main()
{
    auto int i;
    printf("%d",i);
    return 0;
}
```

- (B) #include<stdio.h>

```
int main()
{
    int a=1;
    {
        int a=2;
        {
            int a=3;
            printf("%d",a);
        }
        printf(" %d",a);
    }
    return 0;
}
```

- (C) #include<stdio.h>



```
int main()
{
    {
        int a=2;
        printf("%d",a);
    }
    printf(" %d",a);
    return 0;
}
```

(D) None

Q.16 What will be output of following c code?

```
#include<stdio.h>
int main()
{
    int a=0;
    {
        int a=10;
        printf("%d",a);
        a++;
        {
            a=20;
        }
    }
    printf(" %d",a);
    int a=30; {a++;}
    printf(" %d",a++);
}
printf(" %d",a++);
return 0;
}
```

Q.17 What will be the output of the C program?

```
#include<stdio.h>
static int i=2;
extern int i=4;
int main()
{
    printf("%d",i);
    return 0;
}
```

(A) 2

(B) 4

(C) 0

(D) Compilation

Error



Q.18 What will be the output of the C program?

```
void f(int n)
{
    if(n<=0)
        return;
    f(n-1);
    printf("%d",n);
    f(n-1);
}
```

The output of f(4) is _____

Q.19 What will be the output of the C program?

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

The output of f(22) is _____

Q.20 The output of the code is :

```
int fun(int x)
{
    if(x%2==0)
        return fun(fun(x-1));
    else
        return(x++);
}
int main()
{
    printf("%d",fun(12));
    return 0;
}
```

(A) 10

(B) 11

(C) 12

(D) None of these



Classroom Practice Questions

1	D	2	E	3	E	4	E	5	C
6	D	7	A	8	C	9	C	10	A
11	C	12	D	13	230	14	B	15	C
16	B	17	C	18	C	19	C	20	D
21	B	22	C	23	B	24	51	25	C
26	D	27	C	28	C	29	D	30	A
31	55	32	A	33	B	34	C	35	D
36	D	37	D	38	C				

Self-Practice Questions

1	A	2	D	3	9	4	k = 38	5	A
6	D	7	D	8	D	9	D	10	A
11	C	12	A	13	D	14	A	15	C
16	10 20 31 20 0	17	D	18	1213121 41213121	19	33	20	B

□□□

Classroom Questions

Q.1 What will be output when you will execute following c code?

```
#include<stdio.h>
void main()
{
    int arr[4]={10,20};
    printf("%d",1[arr]);
}
```

- (A) 0 (B) 10
 (C) 20 (D) Compilation error

Q.2 What will be output when you will execute following c code?

```
#include<stdio.h>
void main()
{
    int 4[arr]={10,20};
    printf("%d",1[arr]);
}
```

- (A) 0 (B) 10 (C) 20 (D) Compilation

error

Q.3 What is the output of the following C code? Assume that the address of X is 2000 (in decimal) and an integer requires four bytes of memory. **GATE 2015**

```
int main ()
{
    unsiged int x[4] [3] = {{1, 2, 3}, {4, 5, 6}, {7, 8, 9}, {10, 11, 12}};
    printf("%u, %u,%u", x + 3, *(x +3), *(x +2) +3);
}
```

- (A) 2036, 2036, 2036 (B) 2012, 4, 2204 (C) 2036, 10, 10 (D) 2012, 4, 6

Q.4 Consider the code :

```
void main ( )
{
    int a[4]={10,20,30, 40,50}
    printf ("%u",a);
    printf ("%u",a[0]);
    printf ("%u",a+1);
    printf ("%u",&a+1);
}
```

Assuming the base address of the array to be 1000 and size of integer is 4 byte, what are the values printed by printf() statements?

- (A) 10 10 20 20 (B) 1000 1000 20 20
 (C) 1000 10 20 1016 (D) 1000 10 1004 1016

Q.5

Consider the code:

```
void main ()
{
    int a[2][3]={1,2,3,4,5,6};
    printf ("%u",a);
    printf ("%u",a[0]);
    printf ("%u",a[0]+1);
    printf ("%u",&a+1);
    printf ("%u",a[0][0]);
}
```

Assuming the base address of the array to be 1000 and size of integer is 4 byte, what are the values printed by printf() statements?

- (A) 1000 1000 1004 1024 1 (B) 1000 1000 1012 1024 1
 (C) 1000 1 1012 1024 1 (D) 1000 1000 1006 1024 1

Q.6

Assuming base address 100 and size of integer as 4 bytes

```
int a[3][2][2]={1,2,3,4,5,6,7,8,9,10,11,12};
printf("%u",a);
printf("%u",a+1);
printf("%u",*a);
printf("%u",*a+1);
printf("%u",&a +1);
printf("%u",**a);
printf("%u",***a);
printf("%u",**a +1);
printf("%u",***a +1);
```

What is the output of above printf statements regarding the 3D array declaration?

Q.7

void main ()

```
{
    int a[2][3]={1,2,3,4,5,6};
    printf ("%u %u %u",a,*a,**a);
    printf ("%u %u %u %u",a+1,*a+1,**a+1);
}
```

Assuming the base address of the array to be 1000 and integer size to be 4 byte, what are the values printed by printf statements?

- (A) 1000 1000 1 1012 1004 5 (B) 1000 1000 1000 1012 1004 1004
 (C) 1000 1000 1 1012 1008 5 (D) None of these

Q.8

void main ()

```
{
    int a[2][3][2]={1,2,3,4,5,6,7,8,9,10,11,12};
    printf ("%u %u %u %u",a,*a,**a,***a);
    printf ("%u %u %u %u",a+1,*a+1,**a+1,***a+1);
```

}

Assuming the base address of the array to be 1000 and the size of integer is 4 bytes, what are the values printed by printf statements

Q.9

The output of the following code is:

```
#include<stdio.h>
```

```

int main()
{
    int a[2] = {1, 2};
    void *ptr = &a;
    ptr = ptr + sizeof(int);
    printf("%d", *(int *)ptr);
    return 0;
}

```

(A) 2

(B) 6

(C) Compilation Error (D) None of these

Q.10 What does the following declaration signifies :

(A) int (*p) [4]

(B) int * (*p) [5]

(C) int * p[10]

(D) int (*p) ()

(E) int (*p) (int, int)

(F) int (*p) (char *a)

Q.11 What does the following C-statement declare?

int (* f) (int *);

GATE 2005

(A) A function that takes an integer pointer as argument and returns an integer

(B) A function that takes an integer as argument and returns an integer pointer

(C) A pointer to a function that takes an integer pointer as argument and returns an integer.

(D) A function that takes an integer pointer as argument and returns a function pointer

Q.12 Consider the following program

#include<stdio.h>

int main()

{

int a[4]={10,20,30,40};

int *p[4]={a+3,a+2,a+1,a};

int y;

y=--p[0]-p[1];

printf("%d",y);

printf("%d",*p[0]);

}

(A) 0 20

(B) 1 30

(C) 0 30

(D) 0 10

Q.13 What will be the output of the following program?

#include<stdio.h>

int main()

{

int a=5,b=10,c=15;

int *p[3]={&a,&b,&c};

printf("%d",*p[*p[1]-8]);

return 0;

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Programming-C

}

(A) Segmentation Fault

(B) Compilation Error

(C) 15

(D) 10

Q.14 Consider the following C program**GATE 2015**

include < stdio.h>

int main ()



```

{
    static int a[ ] = {10, 20, 30, 40, 50};
    static int *p[ ] = {a, a+3, a+4, a+1, a+2};
    int **ptr = p;
    ptr++;
    printf ("%d%d", ptr-p, **ptr);
}

```

The output of the program is_____.

Q.15 Consider the following program

```

#include<stdio.h>
int fun1()
{
    printf("GATE ACADEMY");
    return 0;
}
int fun2()
{
    printf("Pankaj");
    return 0;
}
int main()
{
    int (*p[2])();
    p[0] = fun1;
    p[1] = fun2;
    p[1]();
    return 0;
}

```

(A) Pankaj

(B) GATE ACADEMY

(C) Compilation Error

(D) pankajGATE ACADEMY

Q.16 Consider the C program shown below.

```

# include <stdio.h>
# define print (x) printf("%d", x)
int x;
void Q (int z)
{
    z += x; print (z);
}

```

```

void p (int *y)
{
    int x = *y + 2;
    Q (x); *y = x - 1;
    print (x);
}
main (void)
{
}
```

```

    x = 5;
    p(&x);
    print (x);
}

```

The output of this program is

GATE 2003

- (A) 12 7 6 (B) 22 12 11 (C) 14 6 6 (D) 7 6 6

Q.17 Consider the following snippet of a C program. Assume that swap (&x, &y) exchanges the contents of x and y.

GATE 2017

```

int main ()
{
    int array [ ] = {3, 5, 1, 4, 6, 2};
    int done = 0;
    int i;
    while (done == 0)
    {
        done = 1;
        for (i = 0; i <= 4; i++)
        {
            if (array[i] < array[i+1])
            {
                swap (& array [i], & array [i+1]);
                done = 0;
            }
        }
        for (i = 5; i >= 1; i --)
        {
            if (array[i] > array [i -1])
            {
                swap(&array[i], &array[i-1]);
                done = 0;
            }
        }
    }
    printf("%d", array [3]);
}

```

The output of the program is ____.

Q.18 Consider the C code to swap two integers and these five statements. The code

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Programming-C



GATE 2006

```

void swap (int * px, int * py )
{
    * px = *px -*py;
    * py= *px +*py;
    *px = *py -*px;
}

```

S1 : will generate a compilation error

- S2 : may generate a segmentation fault at runtime depending on the arguments passed
 S3 : correctly implements the swap procedure for all input pointers referring to integers stored in memory locations accessible to the process
 S4 : implements the swap procedure correctly for some but not all valid input pointers
 S5 : may add or subtract integers and pointers
- (A) S1 (B) S2 and S3 (C) S2 and S4 (D) S2 and S5

Q.19 #include <stdio.h>

```
void f(int *);  
int main()  
{  
    int a[2][3]={1,2,3,4,5,6};  
    f(a[1]);  
    printf("%d %d",a[1][1],a[1][2]);  
}  
void f(int *p)  
{    p--;  
    *p=*p**p;  
    p--;  
    *p=*p**p;  
}
```

The output is _____

Q.20 Assume the following C variable declaration

int *A [10], B[10][10];

Of the following expressions

1. A[2]
2. A[2][3]
3. B[1]
4. B[2][3]

Which will not give compile-time errors if used as left hand sides of assignment statements in a C program?

GATE 2003

- (A) 1, 2, and 4 only (B) 2, 3, and 4 only (C) 2 and 4 only

- (D) 4 only

Q.21 Consider the following C program.

```
# include <stdio. h>  
int main ()  
{  
    int a [4][5]={ {1,2,3,4,5},  
                  {6,7,8,9,10},  
                  {11,12,13,14,15},  
                  {16,17,18,19,20} };  
    print f ("%d\n", *(*(a + ** a + 2 ) + 3 ));
```



return (0);

}

The output of the program is _____.

Q.22 Consider the following function implemented in C:

```
void printxy (int x, int y)  
{  
    int *ptr  
    x = 0  
    ptr = &x;  
    y = *ptr;
```

```
*ptr = 1;  
printf ("%d, %d", x, y);  
}
```

The output of invoking printxy (1, 1) is

GATE 2017

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

Q.23 Which of the following declarations are allowed in c programming?

- (i) int A[2][3]={1,2};
- (ii) int A[][][3]={1};
- (iii) int A[2][]={1};
- (iv) int A[][],={1};
- (v) int A[][],[2][3]={1,2};
- (vi) int A[],[3];
- (vii) int A[2][,3];
- (viii)int A[],[3][4]={1};

Q.24 Consider the following program

```
#include <stdio.h>  
void f(int (* )[ ]);  
int main()  
{  
    int a[2][3]={1,2,3,4,5,6};  
    f(a);  
    printf("%d %d %d",a[1][0],a[1][1],a[1][2]);  
}  
void f(int ( *p )[3])  
{  
    p++;  
    **p=**p***p;  
    **(p+1)=***(p+1)****(p+1);  
}
```

The output is _____

Q.25 What is the value printed by the following C program?

GATE 2010

```
#include<stdio.h>  
int f(int *a, int n)
```

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Programming-C



```
{  
    if(n <= 0)  
        return 0;  
    else if(*a % 2 == 0)  
        return *a + f(a+1, n-1);  
    else  
        return *a - f(a+1, n-1);  
}  
int main()  
{  
    int a[] = {12, 7, 13, 4, 11, 6};  
}
```

```
    printf("%d", f(a, 6));
    getchar();
    return 0;
}
```

(A) -9

(B) 5

(C) 15

(D) 19

Q.26 Consider the program below :

```
# include <stdio . h>
int fun (int n, int *f_p)
{
    int t, f ;
    if (n < = 1)
    {
        * f_p = 1 ;
        return 1;
    }
    t = fun (n - 1, f_p) ;
    f = t + * f_p ;
    * f_p = t;
    return f ;
}
int main ()
{
    int x = 15 ;
    printf (" % d / n", fun (5, &x)) ;
    return 0;
}
```

The value printed is :

GATE 2009

(A) 6

(B) 8

(C) 14

(D) 15

Q.27 Which one of the choices given below would be printed when the following program is executed?

GATE 2006

```
#include <stdio.h>
void swap (int*x, int*y)
{
    static int*temp;
    temp = x;
```



```
x = y;
y = temp ;
}
void printab ()
{
    static int i, a = -3, b = - 6;
    i = 0;
    while (i<=4)
    {
        if ((i++)% 2 == 1) continue;
        a = a+i;
        b = b+i;
    }
}
```

```
    swap (&a, &b);
    printf ("a =%, b= %d\n", a, b);
}
main ()
{
    printab();
    printab();
}
```

(A) a = 0, b = 3

(B) a = 3, b = 0
a = 12, b = 9

(C) a = 3, b = 6
a = 3, b = 6

(D) a = 6, b = 3
a = 15, b = 12

Q.28 Consider the following program :

GATE 2016

```
int f (int *p, int n)
{
    if (n < = 1) return 0;
    else
        return max (f (p +1, n-1), p[0]-p [1]);
}
int main ( )
{
```

int a [] = {3, 5, 2, 6, 4};

printf ("%d", f(a, 5));

}

Note : max (x, y) returns the maximum of x and y. The value printed by this program is _____.

Q.29 Consider the following program

```
#include <stdio.h>
void f(int *);
int main()
{
    int a[]={1,2,3,4,5};
    f(a+1);
```

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Programming-C



```
    printf("%d %d",a[2],a[3]);
}
void f(int *p)
{
    *p=*p**p;
    *(p+1)=*(p+1)**(p+1);
    *(p+2)=*(p+2)**(p+2);
}
(A) 9 16
(B) 4 9
(C) Compilation Error
(D) None
```

Q.30 #include <stdio.h>

#include <stdlib.h>

int main(void)

{

: : : .

```

int i;
int *ptr = (int *) malloc(5 * sizeof(int));
for (i=0; i<5; i++)
    *(ptr + i) = i;
printf("%d ", *ptr++);
printf("%d ", (*ptr)++);
printf("%d ", *ptr);
printf("%d ", *++ptr);
printf("%d ", ++*ptr);
}

```

(A) Compiler Error (B) 0 1 2 2 3

(C) 0 1 2 3 4

(D) 1 2 3 4 5

Q.31 Consider the following C code :

```

#include<stdio.h>
int *assignval (int *x, int val)
{
    *x = val;
    return x;
}
void main ()
{
    int *x = malloc (sizeof (int));
    if (NULL == x) return;
    x = assignval (x, 0);
    if (x)
    {
        x = (int *) malloc (sizeof (int));
        if (NULL == x) return;
        x = assignval (x, 10);
    }
    printf("%d/n", *x);
    free (x);
}

```

}

The code suffers from which one of the following problems :

GATE 2017

- (A) Compiler error as the return of malloc is not typecast appropriately
- (B) Compiler error because the comparison should be made as $x == \text{NULL}$ and not as shown
- (C) Compiles successfully but execution may result in dangling pointer
- (D) Compiles successfully but execution may result in memory leak

Q.32 Consider the following three C functions :

GATE 2001

[P1]

```

int * g (void)
{
    int x = 10;
    return (&x);
}

```

[P2]

```

int * g (void)

```

```

    {
        int * px;
        *px = 10;
        return px;
    }
[P3]
int *g (void)
{
    int *px;
    px = (int *) malloc (sizeof(int));
    *px = 10;
    return px;
}

```

Which of the above three functions are likely to cause problems with pointers?

- (A) Only P3 (B) Only P1 and P3 (C) Only P1 and P2 (D) P1, P2 and P3

Q.33 The most appropriate matching for the following pairs

GATE 2000

List - I

- X. m=malloc(5); m= NULL;
- Y. free(n); n->value=5;
- Z. char *p; *p = 'a';

List - II

1. using dangling pointers
 2. using uninitialized pointers
 3. lost memory
- (A) X-1 Y-3 Z-2 (B) X-2 Y-1 Z-3 (C) X-3 Y-2 Z-1 (D) X-3 Y-1 Z-2

Q.34 Consider the following C functions.

GATE 2020

```

int tob (int b, int* arr)
{
    int i;
    for (i = 0; b > 0; i++)

```



```

    {
        if (b%2) arr [i]=1;
        else arr [i]=0;
        b = b/2;
    }
    return(i);
}
int pp (int a, int b)
{
    int arr [20];
    int i, tot = 1, ex, len;
    ex = a;
    len = tob (b, arr);
    for (i = 0; i < len; i++)
    {
        if (arr [i]==1)

```

```

        tot = tot * ex;
        ex = ex * ex;
    }
    return (tot);
}

```

The value returned by pp(3,4) is _____.

Q.35 The value printed by the following program is _____. GATE 2016

```

void f (int* p, int m)
{
    m = m + 5;
    *p = *p + m;
    return;
}

void main ( )
{
    int i = 5, j = 10;
    f (& i, j);
    printf ("%d", i + j);
}

```

Q.36 Consider the following C program. GATE 2016

```

#include<stdio.h>
void mystery (int *ptrA, int * ptrB)
{
    int *temp;
    temp = ptrB;
    ptrB = ptrA;
    ptrA = temp;
}
int main ( )

```

```

    {
        int a = 2016, b = 0, c = 4, d = 42;
        mystery (&a, &b);
        if (a < c)
            mystery (&c, &a);
        mystery(&a, &d);
        printf("%d\n",a);
    }

```

The output of the program is _____. GATE 2013

Q.37 What is the return value of f(p, p), if the value of p is initialized to 5 before the call? Note that the first parameter is passed by reference, whereas the second parameter is passed by value. GATE 2013

```

int f (int &x, int c)
{
    c = c - 1;
    if (c == 0) return 1;
    x = x + 1;
    return f(x, c) * x;
}

```

(A) 3024

(B) 6561

(C) 55440

(D) 161051

Q.38 Consider the following C function

```
void swap (int a, int b)
{
    int temp;
    temp = a;
    a = b;
    b = temp;
}
```

In order to exchange the values of two variables x and y.

GATE 2004

(A) Call swap (x, y)

(B) Call swap (&x, &y)

(C) swap(x,y) cannot be used as it does not return any value

(D) swap(x,y) cannot be used as the parameters are passed by value

Q.39 Consider the C program below. What does it print?

GATE 2008

```
# include <stdio.h>
# define swap1 (a,b) tmp = a ;
a = b;
b = tmp;
void swap2 ( int a, int b)
{
    int tmp ;
    tmp = a; a=b; b=tmp;
}
void swap3 (int *a , int*b)
```

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Programming-C

```
{
    int tmp;
    tmp = *a; *a =*b; *b= tmp;
}
int main ( )
{
    int num1=5, num2 =4, tmp;
    if (num1<num2)
    {
        swap1 ( num1, num2) ;
    }
    if (num1 <num2)
    {
        swap2 (num1+1, num2) ;
    }
    if (num1 >= num2)
    {
        swap3 (&num1,&num2) ;
    }
    printf ("%d %d", num1, num2);
}
```

```
printf ( "%d, %d , %d,%d" ),
```

```
}
```

(A) 5, 5

(B) 5, 4

(C) 4, 5

(D) 4, 4

GATE 2010

Q.40 What does the following program print?

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

(A) 2 2

(B) 2 1

(C) 0 1

(D) 0 2

Q.41 The output of the following C program is ____.

GATE 2015

```
void f1 (int a, int b)
{
    int c;
    c = a; a = b; b = c;
}
void f2 (int *a, int *b)
{
```

Programming-C

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```
int c;
c = *a; *a = *b; *b = c;
}
int main ( )
{
    int a = 4, b = 5, c = 6;
    f1 (a,b);
    f2 (&b, &c );
    printf ("%d", c - a - b);
    return 0;
}
```

Q.42 Consider the following C program.

```
void f (int, short);
void main ( )
{
    int i = 100;
    short s = 12;
    short *p = &s;
    _____;
```

Which one of the following expressions, when placed in the blank above, will NOT result in a type checking error?

GATE 2016

(A) $f(s, *s)$ (B) $i = f(i, s)$ (C) $f(i, *s)$

(D) $f(i, *p)$

Q.43 Consider the C program given below. What does it print?

GATE 2008

```
# include <stdio.h>
int main ( )
{
    int i, j ;
    int a [ 8 ] = { 1, 2, 3, 4, 5, 6, 7, 8 } ;
    for ( i = 0 ; i < 3 ; i ++ )
    {
        a [ i ] = a [ i ] + i ;
        i ++ ;
    }
    i -- ;
    for ( j = 7 ; j > 4 , j -- )
    {
        int i = j/2 ;
        a[ i ] = a [ i ] - 1 ;
    }
    printf ( “ %d, %d”, i, a [ i ] ) ;
}
```

(A) 2, 3

(B) 2, 4

(C) 3, 2

(D) 3, 3

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Programming-C

Q.44 Consider the following C program :

GATE 2019

```
#include <stdio.h>
int main ( )
{
    int a [ ] = {2, 4, 6, 8, 10};
    int i, sum = 0, *b = a + 4;
    for (i = 0, i < 5, i++)
        sum = sum + (*b - i) - * (b - i);
    printf (“%d\n”, sum);
    return 0;
}
```

The output of the above C program is _____.

Q.45 Consider the following C program:

GATE 2019

```
# include <stdio.h>
int main ( )
{
    int arr[ ]={1,2,3,4,5,6,7,8,9,0,1,2,5}, *ip=arr+4;
    printf (“%d\n”,ip[1]);
    return 0;
}
```

The number that will be displayed on execution of the program is

The number that will be displayed on execution of the program is _____.

- Q.46** Which one of the choices given below would be printed when the following program is executed?

GATE 2006

```
#include<stdio.h>
int a1[]={6, 7, 8, 18, 34, 67};
int a2[]={23, 56, 28, 29};
int a3[]={-12, 27,-31};
int *x[]={a1, a2, a3};
void print (int*a[])
{
    printf("%d",a[0][2]);
    printf("%d",*a[2]);
    printf("%d",*++a[0]);
    printf("%d",*(++a)[0]);
    printf("%d\n",a[-1][+1]);
}
```

```
main ()
{
    print(x);
}
```

- (A) 8, -12, 7, 23, 8 (B) 8, 8, 7, 23, 7
 (C) -12, -12, 27, -31, 23 (D) -12, -12, 27, -31, 56

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Practice Questions

- Q.1** If the address of pointer ptr is 2000, then what will the output of following program ?
 [Assuming 4 bytes integer size]

```
#include <stdio.h>
int main()
{
    void *ptr;
    ++ptr;
    printf("%u",ptr);
    return 0;
}
```

- (A) 2004 (B)2001 (C) 2000 (D) ERROR

- Q.2** Consider the following program

```
void main ( )
{
    int a[2][3][2]={1,2,3,4,5,6,7,8,9,10,11,12};
    printf("%u",a);
    printf ("%u",a[0]);
    printf ("%u",a[0][0]);
    printf ("%u",&a);
    printf ("%u",a[0]+1);
```

```
    printf ("%u",a[0][0]+1);  
}
```

Assuming the base address of the array to be 1000 and size of integer is 4 bytes, what are the values printed by printf() statements?

- (A) 1000 1000 1 1000 1012 1004 (B) 1000 1000 1000 1000 1008 1004
(C) 1000 1000 1000 1000 1004 1002 (D) None of these

Q.3 The output of the program?

```
#include<stdio.h>  
void main()  
{  
    int a[3]={0,1,2};  
    int i,j,k;  
    i=++a[0];  
    j=a[0]++;  
    k=a[+i];  
    printf("%d %d %d",i ,j, k);  
}  
is _____
```

Q.4 Consider the following program

```
#include <stdio.h>
```

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Programming-C

```
void foo(int[][3]);  
int main(void)  
{  
    int a[2][3][3] = {{ {1, 2, 3}, {4, 5, 6}, {7, 8, 9}}, { {11, 12, 13}, {14, 15, 16}, {17, 18, 19}}};  
    foo(a[1]);  
    return 0;  
}  
void foo(int b[][3])  
{  
    ++b;  
    b[1][1] = 9;  
}
```

After execution of the above code the value updated is

- (A) 9 (B) 15 (C) 18 (D) None

Q.5 What will be the output when you will execute the following C code?

```
void main ()  
{  
    int a[2][3]={5,10,15,20,25,30};  
    int (*p)[2][3]=&a;  
    printf("%d \t",***ptr);  
    printf("%d \t",*** (ptr+1));  
    printf("%d \t",**(*ptr+1));  
    printf("%d \t",*(*(ptr+1)+2));  
}
```

- }
- (A) 5 Garbage 20 30 (B) 10 15 30 20
 (C) 5 15 20 30 (D) C.E
 (E) none

Q.6 What will be output when you will execute following c code?

```
#include<stdio.h>
void main()
{
    int arr[4][2]={3,6,9,12,15,18,21,24};
    printf("%d %d",*(arr+2)[1],**(arr+3));
}
```

Choose all that apply:

- (A) 15 21 (B) 18 21 (C) 15 15 (D) 21 21

Q.7 Which of the following will print the value 2 for the above code?

```
#include<stdio.h>
int main()
{
    int a[10][20][30] = {0};
    a[5][2][1] = 2;
    return 0;
```

- }
- (A) printf("%d",*((a+5)+2)+1)); (B) printf("%d",***((a+5)+2)+1);
 (C) printf("%d",*(*(a+5)+2)+1)); (D) None of these

Q.8 What is the output of the following program?

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

(A) 2 3 5 6 (B) 2 3 4 5
 (C) 4 5 0 0 (D) none of the above

Q.9 What is the output of the following code?

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

(A) 2 5 (B) Garbage value

(C) Compiler Error

(D) Segmentation fault

Q.10 What will be the output of the C program?

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

(A) 0 1 3 4

(B) 0 1 0 1

(C) 0 1 2 3

(D) 0 1 1 2

Q.11 What will be the output of the C program?

```
#include<stdio.h>
int main()
{
    int a[2][3][2]={{1,2},{3,4},{5,6}},{7,8},{9,10},{11,12}};
```

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```
int *ptr = a[0][0];
ptr++;
*++ptr;
++*ptr;
++ptr;
printf("%d%d",*(ptr-1),*ptr);
return 0;
```

}

(A) 4 4

(B) 3 4

(C) 4

(D) 2 3

Q.12 What will be the output of the C program?

```
#include<stdio.h>
int main()
{
    int a[2][3][2]={{1,2},{3,4},{5,6}},{7,8},{9,10},{11,12}};
    int *ptr = a[0][0];
    ptr++;
    *++ptr;
    ++*ptr;
    ++*ptr;
    printf("%d%d",*(ptr-1),*ptr);
    return 0;
}
```

(A) 4 5

(C) 1 5

(B) 3 4

(D) Compilation Error

Q.13 Consider the following program

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

```

    int array[10];
    int *i = &array[2], *j = &array[5];
    int diff = j-i;
    printf("%d", diff);
}

```

- (A) 3 (B) 6 (C) Garbage value (D) Error

Q.14 Consider the following program

```

#include <stdio.h>
int * build_array();
int main()
{
    int *a,k;
    a = build_array();
    for (k = 0; k < 5; k++)
        printf("%d ", a[k]);
    return 0;
}
int * build_array()

```

```

{
    int arr[5]={1,2,3,4,5};
    return arr;
}
```

The output is :

- (A) 1 2 3 4 5 (B) Segmentation Error
 (C) Null pointer Error (D) None

Q.15 Consider the following program

```

#include <stdio.h>
int * build_array();
int main()
{
    int *a,k;
    a = build_array();
    for (k = 0; k < 5; k++)
        printf("%d ", a[k]);
    return 0;
}
int * build_array()

```

```

{
    static int arr[5]={1,2,3,4,5};
    return arr;
}
```

The output is :

- (A) Compilation Error (B) Runtime Error
 (C) 1 2 3 4 5 (D) None

Q.16 Consider the following program. What will be the output

```

#include <stdio.h>
int main()
{
    int a=10,x;
```

```

int *p,**q;
p=&a;
q=&p;
x=a**p***q;
printf("%d",x);
return 0;
}

```

- (A) 100 (B) 1000 (C) 10 (D) Error

Q.17 Consider the following program. What will be the output

```

#include<stdio.h>
int main()
{
    int a=20,*p;
    p=&a;
    *p=++a -*p;
    printf("%d",*p);
    return 0;
}

```

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Programming-C



- (A) 0 (B) 21 (C) 20 (D) 1

Q.18 Consider the following program

```

#include<stdio.h>
void fun(int);
int main()
{
    void (*ptr)(int ) = fun;
    (*ptr)(2);
    return 0;
}

```

```

void fun(int n)
{
    int i;
    for(i=1; ; i++)
    {
        if(i<=n)
            printf("pankaj");
        else
            break;
    }
}

```

The output is :

- (A) Compilation Error (B) Runtime Error
 (C) Will print pankaj infinite times (D) pankajpankaj

Q.19 Consider the following program

```

void fun(int n);
#include<stdio.h>
int main()
{
    void (*ptr)(int ) = fun;
    (*ptr)(2);
    return 0;
}
void fun(int n)
{
    ...
}
```

```

for(i=1;; i++)
{
    if(i<=n)
        printf("Pankaj");
}

```

The output of the program is _____?

Q.20 A function 'p' that accepts a pointer to a character as argument and returns a pointer to an array of integer can be declared as

- (A) int(*p(char *))[] (B) int *p(char *)[] (C) int (*p)(char *)[] (D) None of these.

Answer Key

Classroom Practice Questions

1	C	2	D	3	A	4	D	5	A
6	*	7	D	8	*	9	C	10	*
11	C	12	C	13	C	14	1 40	15	A
16	A	17	3	18	C	19	5 6	20	A
21	19	22	C	23	*	24	16 5 6	25	C
26	B	27	D	28	3	29	A	30	B
31	D	32	C	33	D	34	81	35	30
36	2016	37	B	38	D	39	C	40	D
41	-5	42	D	43	C	44	10	45	6
46	A								

Self-Practice Questions

1	D	2	D	3	211	4	C	5	A
6	D	7	C	8	A	9	A	10	A
11	A	12	C	13	A	14	D	15	C
16	B	17	A	18	D	19	*	20	A

Classroom Practice Questions

6. 100 116 100 108 148 100 1 104 2
8. 1000 1000 1000 1 1024 1008 1004 2
10. A) p is a pointer to an array of 4 integer.
B) p is a pointer to an array of 5 pointer to integers.
C) p is an array of 10 pointer to integer.
D) p is a pointer to a function that takes no arguments and returns an integer value.
E) p is a pointer to a function that takes 2 integer arguments and it returns an integer value.
F) p is a pointer to a function that takes a pointer to character as argument and returns an integer.
23. i, ii, v, vi, vii, viii are valid

Self-Practice Questions

19. Pankaj infinite times

□□□

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Programming-C

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String



Classroom Questions

- Q.1 What will be the output of the following program?

```
#include<stdio.h>
int main()
{
    char arr[10];
    arr="hello";
    printf("%s",arr);
    return 0;
}
```

(A) hello

(B) h

(C) Null

(D) Compilation

error

(E) None of these

- Q.2 Consider the following program:

```
void main ( )
{
    char str[ ]= "GATE ACADEMY";
    printf("%s %s %s,& str[5],& str[5],str + 5);
}
```

What will we get after the execution of the program__

(A) Runtime Error

(B) ACADEMY ACADEMY ACADEMY

(C) CADEMY CADEMY CADEMY

(D) Compiler Error

- Q.3 Consider the following program:

```
#include<stdio.h>
int main()
{
    char arr[]="pankaj";
```

```

char arr1[]="pankaj";
if((arr+1)==(arr1 + 1))
printf("Constant Strings");
else
printf("This will execute");
return 0;
}
(A) Compilation Error
(B) Runtime Error
(C) Constant Strings
(D) This will execute

```

Q.4 Consider the following program:

```

void main ( )
{

```

```

char name [ ]="Pankaj";
printf(name+2);
printf("%s",name+2);
printf("%s",& name[2]);
}

```

Output of the program?

- | | |
|-----------------------|----------------------------|
| (A) Compilation Error | (B) Pankaj Pankaj Pankaj |
| (C) nkaj nkaj nkaj | (D) some Address nkaj nkaj |

Q.5 Consider the following C program segment.

```

#include <stdio.h>
int main ( )
{
    char s1 [7] = "1234", *p;
    p = s1 + 2;
    *p = '\0';
    printf ("% s", s1);
}

```

What will be printed by the program?

- | | | |
|--------|------------|-----------|
| (A) 12 | (B) 120400 | (C) 12041 |
|--------|------------|-----------|

GATE 2015

- | |
|----------|
| (D) 1034 |
|----------|

GATE 2011

Q.6 What does the following fragment of C-program print?

```

char c[] = "GATE2011";
char *p = c;
printf("%s",p+p[3]-p[1]);

```

- | | |
|--------------|-----------|
| (A) GATE2011 | (B) E2011 |
|--------------|-----------|

- | |
|----------|
| (C) 2011 |
|----------|

- | |
|---------|
| (D) 011 |
|---------|

Q.7 C program is given below:

```

#include <stdio.h>
int main ( )
{
    int i, j;
    char a [ 2 ] [ 3 ] = {{ 'a', 'b', 'c'}, {'d', 'e', 'f'} } ;
    char b[3] [2];
    char *p = *b;
    for ( i=0; i < 2; i ++ 0)

```

```

    {
        for ( j = 0; j < 3; j ++ )
        {
            * (p + 2*j + i) = a [i] [j] ;
        }
    }
}

```

What should be the contents of the array b at the end of the program? **GATE 2008**

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Programming-C



- | | | | |
|------------|------------|------------|------------|
| a b | a d | a c | a e |
| (A) c d | (B) b e | (C) e b | (D) d c |
| e f | c f | d f | b f |

Q.8 What is the output printed by the following C code ?

GATE 2008

```

#include <stdio.h>
int main ()
{
    char a [ 6 ] = "world" ;
    int i, j , ;
    for ( i = 0, j = 5; i < j ; a [ i ++ ] = a [ j- - ] );
    printf ( "% s\n", a );
}

```

(A) dlrow (B) Null string (C) dlrlld (D) worow

Q.9 Consider the following C program segment:

```

char p [20] ;
char * s = "string";
int length = strlen (s) ;
for (i=0;i<length;i++)
    p[i]=s[length-i];
printf("%s",p);

```

The output of the program is

GATE 2004

- (A) gnirts (B) string
 (C) gnirt (D) no output is printed

Q.10 What will be the output of the C program?

```

#include<stdio.h>
int main()
{
    char *ptr;
    char str[] = "learn C from Pankaj_sir";
    ptr = str;
    ptr += 12;
    printf(ptr);
    return 0;
}

```

}

(A) Compilation Error

(B) Runtime error

(C) Pankaj_sir

(D) C from Pankaj_sir

Q.11 What will be the output of the C program?

```
#include<stdio.h>
int main()
{
    char *ptr;
    char str[] = "Gurupal_sir";
```

ptr = str;

ptr += 4;

*ptr='\0';

printf(ptr);

return 0;

}

(A) No Output will be printed

(B) pal_sir

(C) Guru\0al_sir

(D) Guru

Q.12 Consider the following C program.

GATE 2017

```
#include <stdio.h>
#include <string.h>
int main ()
{
    char* c = "GATECSIT2017";
    char* p = c;
    printf("%d", (int) strlen ( c + 2[p] - 6 [p] - 1));
    return 0;
}
```

The output of the program is _____.

Q.13 Consider the following C program.

GATE 2017

```
#include <stdio.h>
#include <string.h>
void printlength (char *s, char *t)
{
    unsigned int c =0;
    int len = ((strlen (s) - strlen (t)) > c)? strlen (s):strlen(t);
    printf("%d\n", len);
}
void main ( )
{
    char *x = "abc";
    char *y = "defgh";
    printlength (x, y);
}
```

Recall that strlen is defined in string.h as returning a value of type size_t, which is an unsigned int. The output of the program is _____.

Q.14 Choose the correct option to fill ?1 and ?2 so that the program below prints an input string

```
void reverse (void)
{
    int c;
    if (?1) reverse ();
    ?2
}
```

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Programming-C



```
int main ()
{
    printf (" Enter Text ");
    printf ("\n");
    reverse ();
    printf ("\n");
}

(A) ?1 is (getchar () != '\n')
    ?2 is getchar (c);
(B) ?1 is (c = getchar () ) != '\n'
    ?2 is getchar (c);
(C) ?1 is (c != '\n')
    ?2 is putchar (c);
(D) ?1 is ((c = getchar () ) != '\n')
    ?2 is putchar (c);
```

Q.15 Consider the following function written in the C programming language.

```
void foo (char *a)
{
    if (*a && *a != ' ')
    {
        foo (a + 1);
        putchar (*a);
    }
}
```

The output of the above function on input "ABCD EFGH" is

GATE 2015

- (A) ABCD EFGH (B) ABCD (C) HGFE DCBA (D) DCBA

Q.16 Consider the following program:

```
include<stdio.h>
void main()
{
    char *GA[4+~0]={"Umesh_sir","Pankaj_sir","Gurupal_sir"};
    char *ptr=GA[2+~0];
    *++ptr;
    ++ptr;
    printf("%c",*++ptr);
}
```

Choose all that apply:

- (A) a (B) n

(C) k

(D) Compilation error

Q.17 What will be the output of the following code ?

```
#include<stdio.h>
int main()
{
    char name[]="pankaj"
    int a = sizeof(name);
```

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```
int b= strlen(name)
printf("%d%d",a,b);
return 0;
```

}

(A) 6 6

(B) 7 6

(C) 6 7

(D) 7 7

Q.18 What will be the output of the following code ?

```
#include<string.h>
#include<stdio.h>
int main()
{
    char arr[]={'p', 'a', 'n', 'k','a', 'j', '\0'};
    char *ptr="pankaj";
    char name[]="pankaj";
    printf("%d%d%d",strlen(arr),strlen(ptr),strlen(name));
    return 0;
}
```

(A) 7 6 7

(B) 7 7 7

(C) 6 6 7

(D) 6 6 6

Q.19 Consider the following program

```
#include<stdio.h>
int main()
{
    char * p[] = {"Gurupal", "Pankaj", "Yadunath", "Ramesh", "GATE", "ACADEMY" };
    char ** q[] = {p + 3, p + 2, p + 4, p, p + 5, p + 1};
    char *** r = q + 1;
    printf("%s", *-- *++r);
    return 0;
}
```

The output is _____

Q.20 #include<stdio.h>

```
int main()
{
    char arr[7]={"pankaj"};
    char *ptr ="sharma";
    ptr=arr+3
    strcpy(arr,ptr);
    printf("%c",*arr +2);
    return 0;
}
```

The output of the code is

Q.1 What will be the output of the C program?

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

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Programming-C

```
{
    char *ptr;
    char str[] = "Gurupal_sir";
    ptr = str;
    ptr += 4;
            *ptr='\\0';
    printf(ptr+1);
    return 0;
}
```

(A) No Output will be printed
 (C) Guru\\0al_sir

(B) pal_sir
 (D) al_sir

Q.2 The output of the following code:

```
int main()
{
    printf("Gurupal_sir" + 4);
    return 0;
}
```

is_____

Q.3 Output of the code is :

```
#include<stdio.h>
int main()
{
    int a=10;
    printf("%d" + 1);
    return 0;
}
```

(A) Compilation Error (B) Runtime Error

(C) 11

(D) d

Q.4 Output of the code is:

```
#include<stdio.h>
int main()
{
    int a={10};
    printf("%d" + 1);
    return 0;
}
```

(A) Compilation Error (B) Runtime Error

(C) 11

(D) d

Q.5 Assuming integer size as 4 bytes and address size as 4 bytes, what will be the output of the following code:

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



```

    }
    char arr[]={'p', 'a', 'n', 'k','a', 'j', '\0'};
    char *ptr="pankaj";
    char name[]="pankaj";

    printf("%d%d%d",sizeof(arr),sizeof(ptr),sizeof(name));
    return 0;
}

```

- (A) 7 6 7 (B) 7 7 6 (C) 7 4 7 (D) 6 6 6

Q.6 What will be the output of the following code ?

```

void main ( )
{
    char s1[ ]="Hello";
    char s2[10];
    char *s = “Good Morning”;
    char *q;
    s2 = s1;
    q = s;
    printf("%s",s1);
    printf("%s",q);
}

```

- (A) Compilation Error (B) Hello Hello
 (C) Hello Good Morning (D) Good Morning Hello

Q.7 What will be the output of the following code ?

```

#include <stdio.h>
char *p1[] = {"Gurupal", "Sir", "Math", "King"};
char **p2[] = {p1+3, p1+2, p1+1, p1};
char ***ptr = p2;
int main()
{
    printf("%s ", **++ptr);
    printf("%s ", *--*++ptr+3);
    printf("%s ", *ptr[-2]+3);
    printf("%s ", ptr[-1][-1]+1);
    return 0;
}

```

- (A) Math upal g ir (B) Sir pal g ir
 (C) Math pal g ir (D) GarbageValue upal g ir

Q.8 What will be the output of the following code ?

```

#include<stdio.h>
int main()
{
    char my_name[]="pankaj";
    int *ptr;
    int a=20;
}

```

```
ptr=&a;  
*ptr=*(my_name+1)-a;  
printf("%d",a);
```



```
return 0;
```

```
}
```

(A) 0 (B) 77

(C) Compilation error (D) None

Q.9 What will be the output of the following code ?

```
#include<stdio.h>  
int main()  
{  
    char array[7] = "Pankaj", *ptr, i, *ptr1;  
    ptr = &array[2];  
    ptr1 = ptr + 1;  
    *ptr1 = 100;  
    ptr--;  
    for(i = 1; i <= 5;i++)  
        printf("%c", *ptr++);  
    return 0;  
}
```

(A) Compilation Error

(B) ndaj

(C) andaj

(D) ankaj

Q.10 Consider the following program:

```
#include<stdio.h>  
int main()  
{  
    char *ptr1="pankaj";  
    char *ptr2="pankaj";  
    if((ptr1 + 1)==(ptr2 + 1))  
        printf("Constant Strings");  
    else  
        printf("This will execute");  
    return 0;  
}
```

Output of the program?

(A) Compilation Error

(B) Runtime Error

(C) Constant Strings

(D) This will execute

Q.11 Consider the following program:

```
#include<stdio.h>  
int main()  
{  
    char arr[]="pankaj";  
    char *ptr="pankaj";  
    if((arr+1)==(ptr+1))  
        printf("Constant Strings");  
    else  
        printf("This will execute");  
    return 0;  
}
```

Output of the program?



(C) Constant Strings

(D) This will execute

Q.12 What is the output of this program?

```
#include<stdio.h>
int main()
{
    char *ptr;
    char string[] = "How are you?";
    ptr = string;
    ptr += 4;
    printf("%s",ptr);
    return 0;
}
```

(A) How are you? (B) are you?

(C) are

(D) No

Q.13 Consider the following program:

```
void main ( )
{
    char a[2][4]={'p','a','n','k','a','j'};
    printf("%s",*a);
}
```

(A) C.E

(B) Pankaj followed by garbage characters

(C) Pankaj

(D) R.E

Q.14 Consider the following program:

```
void main ( )
{
    char s[ ]="GATE ACADEMY";
    printf(?);
}
```

What would you put in place of "?" to print ACADEMY

(A) s+5

(B) &s[5]

(C) "%s",s+5

(D) "%s",&s[5]

(E) All of these

Q.15 Consider the following program:

```
void main ( )
{
    char s[10]="Pankaj";
    printf("%s",s[1]-s[4]+s);
}
```

Output of the program?

(A) C.E

(B) R.E

(C) Pankaj

(D) ankaj

Q.16 Consider the following program:

```
#include<stdio.h>
#include<string.h>
int main()
{
    char *ptr="pankaj";
    int len,i;
    len=strlen(ptr);
```



```

        for(i=0;i<len;i++)
            printf("%s\n",ptr++);
        return 0;
    }

```

The output is _____

Q.17 Consider the following program:

```

#include <stdio.h>
void f(char **);
int main(void)
{
    char *argv[] = { "ab", "cd", "ef", "gh", "ij", "kl" };
    f(argv);
    return 0;
}
void f(char **p)
{
    char *t;
    t = (p += sizeof(int))[-1];
    printf("%s\n", t);
}

```

What is the output of this program on an implementation where integer types occupy 4 bytes?

Q.18 What will be the output of following program ?

```

#include <stdio.h>
int main()
{
    char * str="pankaj";
    printf("%c\n",*str);
    return 0;
}

```

- (A) Error (B) Pankaj (C) p (D) *p

Q.19 Consider the following program:

```

#include<stdio.h>
int main()
{
    if(strcmp("pankaj","pankaj\0"))
        printf("pankaj");
    return 0;
}

```

The output is_____

Q.20 Consider the following program:

```

void f(char * x)
{
    if((*x)!='\0')
    {

```



```
f(x+1);  
f(x+1);  
printf("%c",*x);  
}  
}  
int main()  
{  
    f("xyz");  
    return 0;  
}
```

The output is_____.

Answer Key

Classroom Practice Questions									
1	D	2	B	3	D	4	C	5	A
6	C	7	B	8	B	9	D	10	C
11	A	12	17	13	3	14	D	15	D
16	C	17	B	18	D	19	Ramesh	20	m

Self-Practice Questions									
1	D	2	pal_sir	3	D	4	D	5	C
6	A	7	A	8	B	9	C	10	C
11	D	12	B	13	C	14	E	15	C
16	*	17	gh	18	C	19	*	20	zzyzzyx

Self-Practice Questions

16. pankaj
ankaj
nkaj
kaj
aj
j
19. No output



6

Structure and Union



Classroom Questions

Q.1 The following C declarations

```
struct node
{
    int i;
    float j;
};
```

struct node *s[10] ;

define s to be

- (A) An array, each element of which is a pointer to a structure of type node
- (B) A structure of 2 fields, each field being a pointer to an array of 10 elements
- (C) A structure of 3 fields: an integer, a float, and an array of 10 elements
- (D) An array, each element of which is a structure of type node.

GATE 2000

Q.2 Consider the following C program.

```
#include<stdio.h>
struct Ournode
{
    char x,y,z,
};
int main ( )
{
    struct Ournode p={'1','0','a'+2};
    struct Ournode *q=&p;
    printf("%c, %c", *((char *)q + 1),
           *((char *)q + 2));
    return 0;
}
```

The output of this program is :

GATE 2018

- (A) 0, c
- (B) 0,a+2
- (C) '0','a+2'
- (D) '0','c'

Q.3 Which one of the choices given below would be printed when the following program is executed ?

GATE 2006

```
#include <stdio.h>
struct test
{
    int i;
    char *c;
}st[] = {5, "become", 4, "better", 6, "jungle", 8, "ancestor", 7, "brother"};
main ()
```



```
{  
    struct test *p = st;  
    p += 1;  
    ++p -> c;  
    printf("%s,", p++ -> c);  
    printf("%c,", *++p -> c);  
    printf("%d,", p[0].i);  
    printf("%s n", p -> c);  
}
```

- (A) jungle, n, 8, nclastor
(C) etter, u, 6, jungle

- (B) etter, u, 6, ungle
(D) etter, u, 8, ncestor

Q.4 Consider the following C program:

```
#include<stdio.h>  
typedef struct  
{  
    char*a;  
    char*b;  
} t;  
void f1 (t s);  
void f2 (t * p);  
main ()  
{  
    static t s = {"A","B"};  
    printf ("%s %s\n", s.a, s.b);  
    f1(s);  
    printf("%s %s\n", s.a, s.b)  
    f2(&s);  
}  
void f1 (t s)  
{  
    s.a = "U";  
    s.b = "V"  
    printf("%s%s\n", s.a, s.b);  
    return;  
}  
void f2 (t * p)  
{  
    p->a = "V";  
    p->b = "W";  
    printf("%s%s\n", p->a, p->b);  
    return;  
}
```

What is the output generated by the program?

GATE 2004



(A) AB
UV
VW

(B) AB
UV
AB
VW

(C) AB
UV
UV
VW

(D) AB
UV
VW
UV

Q.5 Consider the following C declaration

```
struct
{
    short s[5];
    union
    {
        float y;
        long z;
    }u;
} t;
```

Assume that objects of the type short, float and long occupy 2 bytes, 4 bytes and 8 bytes, respectively. The memory requirement for variable t, ignoring alignment considerations, is

GATE 2000

(A) 22 bytes

(B) 14 bytes

(C) 18 bytes

(D) 10 bytes

Q.6 Consider the following C program:

```
#include<stdio.h>
union my_union{
    int a;
    char b;
    float c;
};
int main()
{
    union my_union x;
    printf("%d",(int)sizeof(x));
    return 0;
}
```

Assuming size of integer and float is 4 bytes.

The output is _____

Q.7 Consider the following C program:

```
#include<stdio.h>
struct my
{
    int a;int b;int c;
};
int main()
{
    struct my x={1,2,3};
    struct my*p;
    p=&x;
    printf("%d",*((int*)p + 2));
}
```

The output is _____

Q.8 Assuming the size of float and double as 4B, 8B respectively, the output of the code :

```
#include <stdio.h>
int main()
{
    struct sample
    {
        double d1;
        float f1;
    }s1;
    union samp
    {
        double d2;
        float f2;
    }u1;
    printf("\nSize of Structure : %d ", sizeof(s1));
    printf("\nSize of Union : %d ", sizeof(u1));
    return 0;
}
```

is _____

Q.9 Consider the following C program:

```
#include <stdio.h>
int main()
{
    enum week{ Sunday, Monday, Tuesday, wednesday, Thursday, Friday, Saturday } ;
    printf("\nSunday = %d ", Sunday);
    printf("\nWednesday = %d ", wednesday);
    printf("\nSaturday = %d ", Saturday);
    return 0;
}
```

The output is _____

Q.10 Consider the following C program:

```
#include<stdio.h>
int main()
{
    int x;
    enum { sunday,monday=-1,tuesday,wednesday};
    x=sunday;
    printf("%d",x);
    return 0;
}
```

The output is :

- (A) 0
- (B) 2
- (C) Compilation Error
- (D) None of these

Q.1 Consider the following C program:

```
# include <stdio.h>
# include <string.h>
struct my_struct
{
    char str[10];
};
int main()
{
    struct my_struct s1, s2;
    strcpy(s1.str, "Pankaj");
    s2 = s1;
    s1.str[0] = 'p';
    printf("%s", s2.str);
    return 0;
}
```

The output is _____

Q.2 Which of the following operators can be applied on structure variables?

- (A) Equality comparison (==) (B) Assignment (=)
(C) Both of the above (D) None of the above

Q.3 Consider the following C program:

```
#include<stdio.h>
struct my_struct
{
    int x;
    struct my_struct link;
};
int main()
{
    struct my_struct temp;
    temp.x = 6;
    temp.link = temp;
    printf("%d", temp.link.x);
    return 0;
}
```

The output is :

- (A) 6 (B) Garbage Value (C) Compilation Error (D) Runtime Error

Q.4 What will be the output of the C program?

```
#include<stdio.h>
int main()
{
    struct my_struct
    {
        int a= 10;
```



```
    printf("%d", s1.name);
    printf("%d", s1.a);
    return 0;
}
```

(A) GATE ACADEMY 10

(B) Nothing will be displayed

(C) Runtime Error

(D) Compilation Error

Q.5 What will be the output of the C program?(Assuming integer size as 2 B)

```
#include<stdio.h>
```

```
int main()
```

```
{
```

```
    union Test
```

```
{
```

```
    int i;
```

```
    int a[20];
```

```
};
```

```
printf("%d", sizeof(union Test));
```

```
return 0;
```

```
}
```

(A) 2

(B) 4

(C) 40

(D) None of the above

Q.6 What will be the output of the C program?

```
#include<stdio.h>
```

```
int main()
```

```
{
```

```
    struct st
```

```
{
```

```
    int i;
```

```
    static int si;
```

```
};
```

```
struct st s = {1, 2};
```

```
printf("%d %d", s.i, s.si);
```

```
return 0;
```

```
}
```

(A) 1 2

(B) Linker Error

(C) Runtime Error

(D) Compilation Error

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

```
#include<stdio.h>
```

```
int main()
```

```
{
```

```
    int i = 2;
```

```
    enum numbers{num1 = i, num2 , num3}n;
```

```
    printf("%d %d %d\n", num1, num2, num3);
```

```
}
```

(A) Compilation Error

(B) 2 3 4

(C) 1 2 3

(D) None of the above

Q.8 What will be the output of the C program?

```
#include<stdio.h>
int main()
{
    struct num
    {
        int i, j, k, l;
    };
    struct num n = {1, 2, 3};
    printf("%d %d %d %d", n.i, n.j, n.k, n.l);
}
```

Q.9 Which of the following is true regarding enum in C Language ?

- (A) Two enum names can have same value.
- (B) If we don't explicitly assign values to enum names ,the compiler by default assigns values starting from 0.
- (C) We can assign values to some name in any order.All unassigned names get value as value of previous name plus one.
- (D) All of these

Q.10 Which of the following is true regarding enum in C Language ?

- (A) The value assigned to enum names must be some integral constant.
- (B) All enum constants must be unique in their scope.
- (C) Both A and B
- (D) None of these

Answer Key

Classroom Practice Questions										
1	A	2	A	3	B	4	B	5	C	
6	4	7	3	8	*	9	*	10	A	
Self-Practice Questions										
1	pankaj	2	B	3	C	4	D	5	C	
6	D	7	A	8	1 2 3 0	9	D	10	C	

Classroom Practice Questions

- 8. 12
8
- 9. Sunday = 0
Wednesday = 3
Saturday = 6

□□□

Theory of Computation

1

DFA, NFA, Minimization Technique and
Product Automation



Classroom Questions

Q.1 The number of substrings (of all lengths inclusive) that can be formed from a character string of length n is

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

[GATE 1989 : IIT Kanpur]

Q.2 State True or False with one line explanation :

A FSM (Finite State Machine) can be designed to add two integers of any arbitrary length (arbitrary number of digits).

[GATE 1994 : IIT Kharagpur]

Q.3 Let $L \subseteq \Sigma^*$ where $\Sigma = \{a, b\}$ which of the following is true?

- (A) $L = \{x | x \text{ has an equal number of } a's \text{ and } b's\}$ is regular
(B) $L = \{a^n b^n | n \geq 1\}$ is regular
(C) $L = \{x | x \text{ has more } a's \text{ than } b's\}$ is regular
(D) $L = \{a^m b^n | m \geq 1, n \geq 1\}$ is regular

[GATE 1997 : IIT Madras]

Q.4 Given $\Sigma = \{a, b\}$, which one of the following sets is not countable.

- (A) Set of all strings over Σ
(B) Set of all languages over Σ
(C) Set of all regular language over Σ
(D) Set of all languages over Σ accepted by Turing machines.

[GATE 1997 : IIT Madras]

Q.5 Which of the following sets can be recognized by a deterministic finite-state automaton?

- (A) The numbers 1, 2, 4, 8, ..., 2^n , ... written in binary.
(B) The numbers 1, 2, 4, ..., 2^n , ... written in unary.

(C) The set of binary strings in which the number of zeros is the same as the number of ones.
(D) The set {1, 101, 11011, 1110111, ...}

[GATE 1998 : IIT Delhi]

Q.6 How many substrings of different lengths (non-zero) can be formed from a character string of length n ?

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

[GATE 1998 : IIT Delhi]

Q.7 Let L be the set of all binary strings whose last two symbols are the same. The number of states in the minimum deterministic finite-state automaton accepting L is

- (A) 2 (B) 5
(C) 8 (D) 3

[GATE 1998 : IIT Delhi]

Q.8 Consider the regular expression $(0+1)^n$, ($0+1$)... n times. The minimum state finite automaton that recognizes the language represented by this regular expression contains :

- (A) n states
(B) $n+1$ states
(C) $n+2$ states
(D) None of the above

[GATE 1999 : IIT Bombay]

Q.9 What can be said about a regular language L over $\{a\}$ whose minimal finite state automaton has two states?

- (A) L must be $\{a^n | n \text{ is odd}\}$
(B) L must be $\{a^n | n \text{ is even}\}$
(C) L must be $\{a^n | n \geq 0\}$
(D) Either L must be $\{a^n | n \text{ is odd}\}$ or L must be $\{a^n | n \text{ is even}\}$

[GATE 2000 : IIT Kharagpur]



Q.10 Consider the following two statements:

- $S_1 : \{0^{2n} | n \geq 1\}$ is a regular language
 $S_2 : \{0^m 1^n 0^{m+n} | m \geq 1 \text{ and } n \geq 1\}$ is a regular language

Which of the following statements is correct?

- (A) Only S_1 is correct
(B) Only S_2 is correct

- (A) Does not form a group
(B) Forms a non-commutative group
(C) Does not have a right identity element
(D) Forms a group if the empty string is removed from Σ^* .

[GATE 2003 : IIT Madras]

Q.15 Consider the following deterministic finite state automation M

- (C) Both S_1 and S_2 are correct
(D) None of S_1 and S_2 is correct

[GATE 2001 : IIT Kanpur]

Q.11 Given an arbitrary non-deterministic finite automaton (NFA) with N states, the maximum number of states in an equivalent minimized DFA is at least

- (A) N^2 (B) 2^N
(C) $2N$ (D) $N!$

[GATE 2001 : IIT Kanpur]

Q.12 Consider a DFA over $\Sigma = \{a, b\}$ accepting all strings which have number of a's divisible by 6 and number of b's divisible by 8. What is the minimum number of states that the DFA will have?

- (A) 8 (B) 14
(C) 15 (D) 48

[GATE 2001 : IIT Kanpur]

Q.13 Consider the following languages :

- $L_1 = \{ww \mid w \in \{a, b\}^*\}$
 $L_2 = \{ww^R \mid w \in \{a, b\}^*, w^R \text{ is the reverse of } w\}$
 $L_3 = \{0^{2i} \mid i \text{ is an integer}\}$
 $L_4 = \{0^{i^2} \mid i \text{ is an integer}\}$

Which of the languages are regular?

- (A) Only L_1 and L_2
(B) Only L_2, L_3 and L_4
(C) Only L_3 and L_4
(D) Only L_3

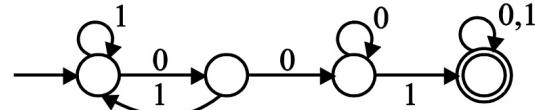
[GATE 2001 : IIT Kanpur]

Q.14 Consider the set Σ^* of all strings over the alphabet $\Sigma = \{0, 1\} \cdot \Sigma^*$ with the concatenation operator for strings

- (B) $\{w \in \{a, b\}^* \mid \text{every } a \text{ in } w \text{ is followed by at least two } b's\}$
(C) $\{w \in \{a, b\}^* \mid w \text{ contains the substring 'abb'}\}$
(D) $\{w \in \{a, b\}^* \mid w \text{ does not contain 'aa' as a substring}\}$

[GATE 2005 : IIT Bombay]

Q.18 If s is a string over $(0+1)^*$ then let $n_0(s)$

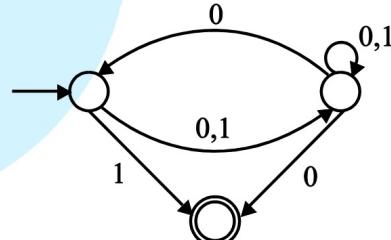


Let S denote the set of seven bit binary strings in which the first, the fourth, and the last bits are 1. The number of strings in S that are accepted by M is

- (A) 1 (B) 5
(C) 7 (D) 8

[GATE 2003 : IIT Madras]

Q.16 Consider the NFA M shown below.

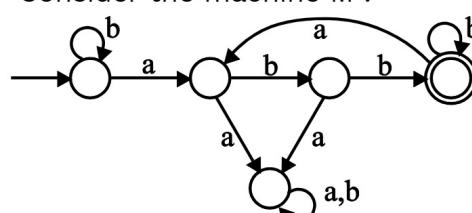


Let the language accepted by M be L . Let L_1 be the language accepted by the NFA, M_1 obtained by changing the accepting state of M to a non-accepting state and by changing the non-accepting state of M to accepting states. Which of the following statements is true?

- (A) $L_1 = \{0, 1\}^* - L$ (B) $L_1 = \{0, 1\}^*$
(C) $L_1 \subseteq L$ (D) $L_1 = L$

[GATE 2003 : IIT Madras]

Q.17 Consider the machine M :



The language recognized by M is :

- (A) $\{w \in \{a, b\}^* \mid \text{every } a \text{ in } w \text{ is followed by exactly two } b's\}$

Q.22 Given below are two finite state automata (\rightarrow indicates the start state and F indicates a final state)

Y :

	a	b
$\rightarrow 1$	1	2
$2(F)$	2	1

Z :

	a	b
$\rightarrow 1$	1	2
$2(F)$	2	1

denote the number of 0's in s and $n_1(s)$ the number of 1's in s . Which one of the following languages is not regular?

- (A) $L = \{s \in (0+1)^* \mid n_0(s) \text{ is a 3-digit prime}\}$
- (B) $L = \{s \in (0+1)^* \mid \text{for every prefix } s' \text{ of } s, |n_0(s') - n_1(s')| \leq 2\}$
- (C) $L = \{s \in (0+1)^* \mid |n_0(s') - n_1(s)| \leq 4\}$
- (D) $L = \{s \in (0+1)^* \mid \begin{cases} n_0(s) \bmod 7 \\ = n_1(s) \bmod 5 = 0 \end{cases}\}$

[GATE 2006 : IIT Kharagpur]

- Q.19** Which of the following is TRUE?
- (A) Every subset of a regular set is regular
 - (B) Every finite subset of a non-regular set is regular
 - (C) The union of two non-regular sets is not regular
 - (D) Infinite union of finite sets is regular

[GATE 2007 : IIT Kanpur]

- Q.20** A minimum state deterministic finite automaton accepting the language

$L = \{w \mid w \in \{0,1\}^* \text{ number of 0's and 1's in } w \text{ are divisible by 3 and 5, respectively}\}$

- (A) 15 states
- (B) 11 states
- (C) 10 states
- (D) 9 states

- Q.21** Which of the following languages is regular?

- (A) $\{ww^R \mid w \in \{0,1\}^+\}$
- (B) $\{ww^Rx \mid x, w \in \{0,1\}^+\}$
- (C) $\{wxw^R \mid x, w \in \{0,1\}^+\}$
- (D) $\{xww^R \mid x, w \in \{0,1\}^+\}$

[GATE 2007 : IIT Kanpur]

Which of the following represents the product automaton ZXY ?

	a	b
→P	S	R
Q	R	S
R(F)	Q	P
S	Q	P

	a	b
→P	S	Q
Q	R	S
R(F)	Q	P
S	P	Q

	a	b
→P	Q	S
Q	R	S
R(F)	Q	P
S	Q	P

- (D) None

[GATE 2008 : IISc Bangalore]

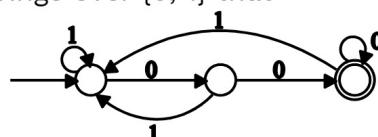
- Q.23** Which of the following are regular sets?

- 1. $\{a^n b^{2m} \mid n \geq 0, m \geq 0\}$
- 2. $\{a^n b^{2m} \mid n = 2m\}$
- 3. $\{a^n b^{2m} \mid n \neq m\}$
- 4. $\{xxy \mid x, y \in \{a, b\}^*\}$

- (A) 1 and 4 only
- (B) 1 and 3 only
- (C) 1 only
- (D) 4 only

[GATE 2008 : IISc Bangalore]

- Q.24** The below DFA accepts the set of all strings over $\{0, 1\}$ that



3

- (A) Begins either with 0 or 1
- (B) End with 0
- (C) End with 00
- (D) Contains the substring 00.

[GATE 2009 : IIT Roorkee]

- Q.25** Let w be any string of length n in $\{0,1\}^*$. Let L be the set of all substrings of w . What is the minimum number of states in a non-deterministic finite automation that accepts L ?

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

	00	01	10	11	q
00		1			0
01		1			
10			0		
11		0			

	00	01	10	11	q
00		1			0
01					1
10	0				
11			0		

[GATE 2010 : IIT Guwahati]

Q.26 Definition of the language L with alphabet $\{a\}$ is given as following.

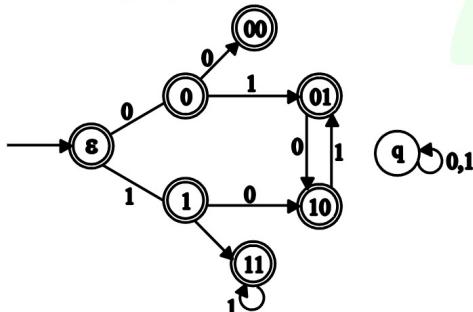
$L = \{a^{nk} \mid k > 0, \text{ and } n \text{ is a positive integer constant}\}$

What is the minimum number of states needed in a DFA to recognize L ?

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

[GATE 2011 : IIT Madras]

Q.27 Consider the set of strings on $\{0, 1\}$ in which, every substring of 3 symbols has at most two zeros. For example, 001110 and 011001 are in the language, but 100010 is not. All strings of length less than 3 are also in the language. A partially completed DFA that accepts this language is shown below.



The missing arcs in the DFA are

	00	01	10	11	q
00	1	0			
01				1	
10	0				
11			0		

	00	01	10	11	q
00		0			1
01		1			
10				0	
11		0			

4

[GATE 2012 : IIT Delhi]

Q.28 Which one of the following is TRUE?

(A) The language $L = \{a^n b^n \mid n \geq 0\}$ is regular.

(B) The language $L = \{a^n \mid n \text{ is prime}\}$ is regular.

(C) The language

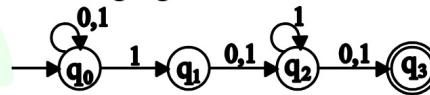
$$L = \left\{ w \mid \begin{array}{l} w \text{ has } 3k+1 \text{ b's for} \\ \text{some } k \in \mathbb{N} \text{ with} \\ \sum = \{a, b\} \end{array} \right\} \text{ is regular.}$$

(D) The language

$$L = \{ww \mid w \in \Sigma^* \text{ with } \Sigma = \{0, 1\}\} \text{ is regular.}$$

[GATE 2014 : IIT Kharagpur]

Q.29 Consider the finite automaton in the following figure.



What is the set of reachable states for the input string 0011?

- (A) $\{q_0, q_1, q_2\}$ (B) $\{q_0, q_1\}$
 (C) $\{q_0, q_1, q_2, q_3\}$ (D) $\{q_3\}$

[GATE 2014 : IIT Kharagpur]

Q.30 If $L_1 = \{a^n \mid n \geq 0\}$ and $L_2 = \{b^n \mid n \geq 0\}$, consider

- (i) $L_1 \cdot L_2$ is a regular language
 (ii) $L_1 \cdot L_2 = \{a^n b^n \mid n \geq 0\}$

Which one of the following is CORRECT?

- (A) Only (i)
 (B) Only (ii)
 (C) Both (i) and (ii)
 (D) Neither (i) nor (ii)

[GATE 2014 : IIT Kharagpur]

Theory of Computation

Q.31 Consider the DFAs M and N given below. The number of states in a minimal DFA that accepts the languages $L(M) \cap L(N)$ is _____.

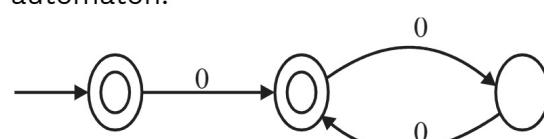


[GATE 2015 : IIT Kanpur]

Q.32 The minimum possible number of states of a deterministic finite automaton that accepts the regular language

$$L = \{w_1 a w_2 \mid w_1, w_2 \in \{a, b\}^*, |w_1| = 2, |w_2| \geq 3\}$$

Consider the language L_1 (over alphabet 0) accepted by the following automaton.



The order of L_1 is _____.

[GATE 2018 : IIT Guwahati]

Q.36 If L is a regular language over $\Sigma = \{a, b\}$, which one of the following languages is NOT regular?

... $\rightarrow R$ ($|$ $\rightarrow R$)

is _____.

[GATE 2017 : IIT Roorkee]

- Q.33** Let δ denote the transition function and $\hat{\delta}$ denote the extended transition function of the ε -NFA whose transition table is given below :

δ	ε	a	b
$\rightarrow q_0$	$\{q_2\}$	$\{q_1\}$	$\{q_0\}$
q_1	$\{q_2\}$	$\{q_2\}$	$\{q_3\}$
q_2	$\{q_0\}$	\emptyset	\emptyset
q_3	\emptyset	\emptyset	$\{q_2\}$

Then $\hat{\delta}(q_2, aba)$ is

- (A) \emptyset (B) $\{q_0, q_1, q_3\}$
 (C) $\{q_0, q_1, q_2\}$ (D) $\{q_0, q_2, q_3\}$

[GATE 2017 : IIT Roorkee]

- Q.34** Let N be an NFA with n states. Let k be the number of states of a minimal DFA which is equivalent to N . Which one of the following is necessarily true?

- (A) $k \geq 2^n$ (B) $k \geq n$
 (C) $k \leq n^2$ (D) $k \leq 2^n$

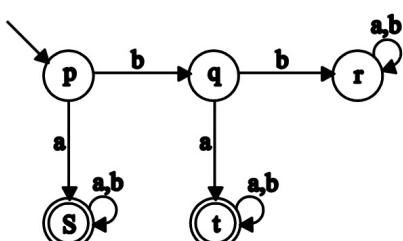
[GATE 2018 : IIT Guwahati]

- Q.35** Given a language L , define L^i as follows :

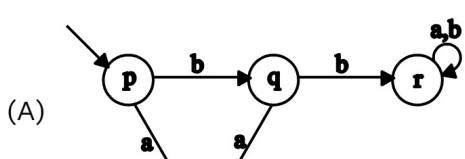
$$L^0 = \{\varepsilon\}$$

$$L^i = L^{i-1} \cdot L \text{ for all } i > 0$$

The order of a language L is defined as the smallest k such that $L^k = L^{k+1}$.



Which of the following finite state machine is a valid minimal DFA which accepts the same language as D ?



$$(A) L \cdot L^* = \{xy \mid x \in L, y^* \in L\}$$

$$(B) \{ww^R \mid w \in L\}$$

$$(C) \text{Prefix}(L) = \left\{ x \in \Sigma^* \mid \exists y \Sigma^* \text{ such that } xy \in L \right\}$$

$$(D) \text{Suffix}(L) = \left\{ y \in \Sigma^* \mid \exists y \in \Sigma^* \text{ such that } xy \in L \right\}$$

[GATE 2019 : IIT Madras]

- Q.37** Let Σ be the set of all bijections from $\{1, \dots, 5\}$ to $\{1, \dots, 5\}$, where id denotes the identity function, i.e. $\text{id}(j) = j$, $\forall j$. Let \circ denote composition on functions. For a string $x = x_1 x_2 \dots x_n \varepsilon \Sigma^n$, $n \geq 0$, let $\pi(x) = x_1 \circ x_2 \circ \dots \circ x_n$.

Consider the language $L = \{x \in \Sigma^* \mid \pi(x) = \text{id}\}$. The minimum number of states in any DFA accepting L is _____.

[GATE 2019 : IIT Madras]

- Q.38** Which of the following statement is false?

- (A) Every finite subset of a non-regular set is regular
 (B) Every subset of a regular set is regular
 (C) Every finite subset of a regular set is regular
 (D) The intersection of two regular sets is regular

[GATE 1998 : IIT Delhi]

- Q.39** A deterministic finite automation (DFA) D with alphabet $\Sigma = \{a, b\}$ is given below

The minimum number of states in a DFA that accepts L is _____.

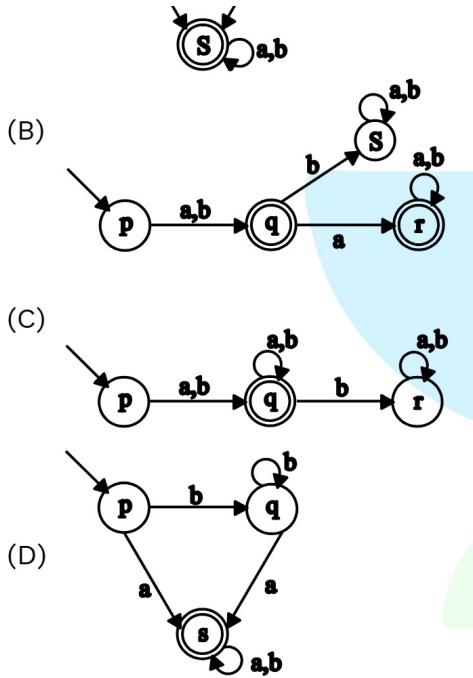
[GATE 2020 : IIT Delhi]

- Q.41** Let R_1 and R_2 be regular sets defined over the alphabet Σ then :

- (A) $R_1 \cap R_2$ is not regular
 (B) $R_1 \cup R_2$ is regular
 (C) $\Sigma^* - R_1$ is regular
 (D) R_1^* is not regular

[GATE 1990 : IISc Bangalore]

- Q.42** The smallest finite automation which accepts the language



[GATE 2019 : IIT Madras]

Q.40 Consider the following language.

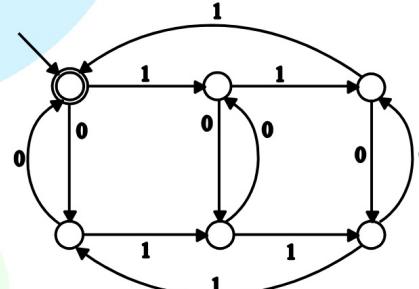
$$L = \left\{ x \in \{a, b\}^* \mid \begin{array}{l} \text{number of } \\ a's \text{ in } x \text{ is} \\ \text{divisible by 2 but not} \\ \text{divisible by 3} \end{array} \right\}$$

$L = \{x \mid \text{length of } x \text{ is divisible by 3}\}$ has

- (A) 2 states
- (B) 3 states
- (C) 4 states
- (D) 5 states

[GATE 2002 : IISc Bangalore]

Q.43 The following finite state machine accepts all those binary strings in which the number of 1's and 0's are respectively



- (A) Divisible by 3 and 2
- (B) Odd and even
- (C) Even and odd
- (D) Divisible by 2 and 3

[GATE 2004 : IIT Delhi]

Practice Questions

Q.1 $L = \{\text{Set of all strings over } \{a, b\} \text{ ending with fixed length symbol } n\}$

Find minimum no. of states in DFA that accept L ?

- (A) 1
- (B) n
- (C) $n - 1$
- (D) $n + 1$

6

Theory of Computation

- (C) No. of final states in minimum DFA will be 6.
- (D) The language ' L ' can be computed by PDA.

Q.3 Find minimum no. of states in a DFA that accept language.

$$L = \{a^n \mid n \geq 0\} \cup \{b^n \mid n \geq 1\} \quad ?$$

Q.4 $L = \{W \in \{0,1\}^* \mid |W| \bmod n < k\}$ where k is positive integer constant and $k < n$.

What is the no. of final states in minimum DFA?

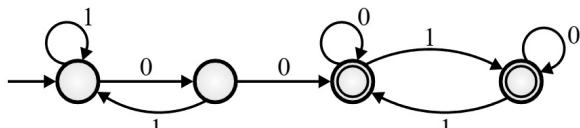
- (A) $n - 1$
- (B) k
- (C) $k - 1$
- (D) $k + 1$

Q.5 $L = \{W \in \{0,1\}^* \mid |W| \bmod n < k\}$ where k

Q.2 $L = \{a^n \mid n \geq 0 \text{ and } n \neq 2, 5, 7\}$ which of the following options is/are TRUE about L ?

- (A) The minimum state DFA will contain 8-states.
- (B) No. of non-final state in minimum DFA will be 3.

Q.9 Which of the following options is/are true about above DFA.



- (A) The language accepted by above DFA is $\{W00W \mid W \in \{0,1\}^*\}$
- (B) The minimum state DFA for M consists of 3-states.
- (C) The regular expression for $L(M)$ is $(0+1)^*00(0+1)^*$
- (D) The language accepted by above DFA is $\{W_100W_2 \mid W_1 \text{ and } W_2 \in \{0,1\}^+\}$

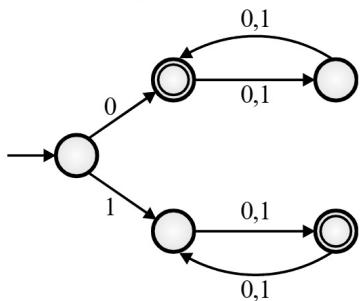
Q.10 $L = \{W \in \{a,b\}^* \mid \#_a(W) \bmod 3 \leq 1 \text{ or }$

is positive integer constant and $k < n$.

Which of the following options is/are TRUE about minimize DFA that accept L ?

- (A) No. of states in DFA is $(n-1)$.
- (B) No. of non-final states in DFA is $(n-k)$.
- (C) No. of final states is $(k-1)$.
- (D) The strings 1011101 is accepted by DFA for $n=5$ and $k=3$.

Q.6 Find minimum no. of states for above DFA _____?



Q.7 $L = \{W \in \{a,b\}^n \mid n \text{ is positive integer constant}\}$

Find minimum number of states in NFA that accept L ?

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

Q.8 $L = \{WxW^R \mid W, x \in \{0,1\}^+\}$

Find minimum number of states in DFA that accept L ?

$\#_b(W) \bmod 4 = 1\}$

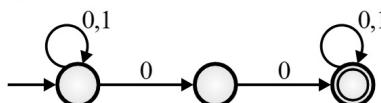
Find no. of final sates in minimum DFA that accept L ?

Q.11 $L = \{W \in \{a,b\}^* \mid \#_a(W) \bmod 4 \leq 2 \text{ and } \#_b(W) \bmod 5 \leq 1\}$

Find no. of non-final sates in minimum DFA?

- (A) The total no. of states in minimum DFA will be 20.
- (B) The no. of final states in minimum DFA will be 8.
- (C) The no. of non-final states in minimum DFA is 14.
- (D) The total no. of states in minimum DFA is 16.

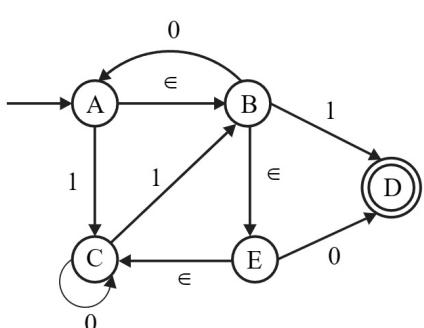
Q.12 **NFA :**



Which of the following options is/are true?

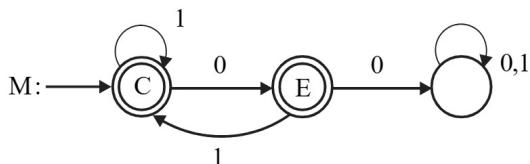
- (A) $L(\text{NFA}) = \{W_1 00 W_2 \mid W_1 \text{ and } W_2 \in \{0,1\}^*\}$
- (B) The complement of language accepted by above NFA is $\{W 0 \mid W \in \{0,1\}^*\}$.
- (C) Conversion of above NFA into DFA will contain 4-states.
- (D) The minimized DFA of above NFA will contain 3-states.

Q.13 What will be $\delta(A, 01)$ for the following automation?



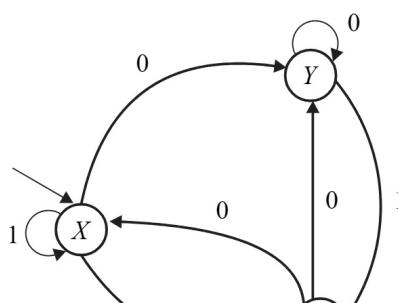
- (A) $\{D\}$
- (B) $\{B, D\}$
- (C) $\{B, C, D\}$
- (D) $\{B, C, D, E\}$

Q.14 Consider following DFA:-



Which of the following options is /are

Q.16 Consider the non-deterministic finite automaton (NFA) shown in the figure. State X is the starting state of the automaton. Let the language accepted by the NFA with Y as the only accepting state be L_1 . Similarly, let the language accepted by the NFA with Z as the only accepting state be L_2 . Which of the following statements about L_1 and L_2 is TRUE?



TRUE?

- (A) It accepts all the strings over $\{0, 1\}$ ending with 0.
- (B) The regular expression for $L(M)$ is $(1+01)^*$
- (C) It accepts set of all string over $\{0, 1\}$ having no two consecutive 0's.
- (D) $L(M) = \{w \in \{0,1\}^* \mid \#(w) \text{ is odd}\}$

Q.15 Let $M = (K, \Sigma, \delta, s, F)$ be a finite state automaton, where

$$\begin{aligned} K &= \{A, B\}, \Sigma = \{a, b\}, s = A, F = \{B\}, \\ \delta(A, a) &= A, \delta(A, b) = B, \delta(B, a) \\ &= B \text{ and } \delta(B, b) = A \end{aligned}$$

A grammar to generate the language accepted by M can be specified as

$$G = (V, \Sigma, R, S), \text{ where } V = K \cup \Sigma, \text{ and } S = A$$

Which one of the following set of rules will make $L(G) = L(M)$?

- (A) $\left\{ \begin{array}{l} A \rightarrow aB, A \rightarrow bA, B \rightarrow bA \\ B \rightarrow aA, B \rightarrow \epsilon \end{array} \right\}$
- (B) $\left\{ \begin{array}{l} A \rightarrow aA, A \rightarrow bB, B \rightarrow ab \\ B \rightarrow bA, B \rightarrow \epsilon \end{array} \right\}$
- (C) $\left\{ \begin{array}{l} A \rightarrow bB, A \rightarrow aB, B \rightarrow aA \\ B \rightarrow bA, B \rightarrow \epsilon \end{array} \right\}$
- (D) $\left\{ \begin{array}{l} A \rightarrow aA, A \rightarrow bA, B \rightarrow ab \\ B \rightarrow bA, A \rightarrow \epsilon \end{array} \right\}$

8



- (A) $L_1 = L_2$

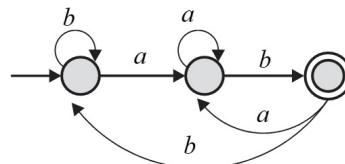
- (B) $L_1 \subset L_2$

- (C) $L_2 \subset L_1$

- (D) None of the above

Q.17

If the final states and non-final states in the DFA below are interchanged, then which of the following languages over the alphabet $\{a, b\}$ will be accepted by the new DFA?



- (A) Set of all strings that do not end with ab

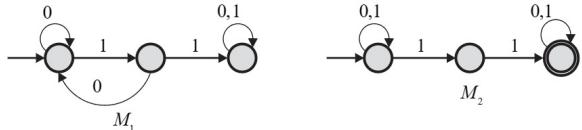
- (B) Set of all strings that begin with either an a or a b

- (C) Set of all strings that do not contain the substring ab

- (D) The set described by the regular expression $b^*aa^*(ba)^*b^*$

Q.18

Consider the following two finite automata. M_1 accepts L_1 and M_2 accepts L_2 which one of the following is true?



Theory of Computation

- (A) $L_1 = L_2$
- (B) $L_1 \subset L_2$
- (C) $L_1 \cap \bar{L}_2 = \emptyset$
- (D) $L_1 \cup L_2 \neq L_1$

Q.19 Choose the correct statement –

- (A) $A = \{a^n b^n \mid n = 1, 2, 3, \dots\}$ is regular language

- (B) The set B, consisting of all strings made up of only a's and b's having equal number of a's and b's defines a regular language
- (C) $L(A^*B) \cap B$ gives the set A
- (D) None of the above

Answer Key

Classroom Practice Questions

1.	D	2.	TRUE	3.	D	4.	B	5.	A
6.	D	7.	B	8.	C	9.	D	10.	A
11.	B	12.	D	13.	D	14.	A	15.	C
16.	B	17.	B	18.	B	19.	B	20.	A
21.	C	22.	D	23.	A	24.	C	25.	C
26.	B	27.	D	28.	C	29.	A	30.	A
31.	1	32.	8	33.	C	34.	D	35.	2
36.	R	37.	120	38.	R	39.	A	40.	G

30.	B	31.	120	32.	B	33.	A	34.	TU.	C
41.	B, C	42.	3	43.						
Practice Questions										
1.	D	2.	B, C, D	3.	4	4.	C	5.	B, D	
6.	3	7.	C	8.	7	9.	B, C, D	10.	9	
11.	A, C	12.	A, C, D	13.	D	14.	B, C	15.	B	
16.	B	17.	D	18.	A	19.	D			

□ □ □

2

Regular Expression



Classroom Questions

Q.1 Let $r = 1(1+0)^*$, $s = 11^*0$ and $t = 1^*0$ be three regular expressions. Which one of the following is true?

- (A) $L(s) \subseteq L(r)$ and $L(s) \subseteq L(t)$
- (B) $L(r) \subseteq L(s)$ and $L(s) \subseteq L(t)$
- (C) $L(s) \subseteq L(t)$ and $L(s) \subseteq L(r)$
- (D) $L(t) \subseteq L(s)$ and $L(s) \subseteq L(r)$

[GATE 1991 : IIT Madras]

Q.2 Which Two of the following four regular expressions are equivalent?

- (i) $(00)^*(\epsilon + 0)$
- (ii) $(00)^*$
-

Q.6 Let S and T be languages over $\Sigma = \{a, b\}$ represented by the regular expressions $(a + b^*)^*$ and $(a + b)^*$, respectively. Which of the following is true?

- (A) $S \subset T$
- (B) $T \subset S$
- (C) $S = T$
- (D) $S \cap T = \emptyset$

[GATE 2002 : IISc Bangalore]

Q.7 The regular expression $0^*(10^*)^*$ denotes the same set as
(A) $(1*0)^*1*$

- (iii) 0^*
 (iv) $0(00)^*$
 (A) (i) and (ii) (B) (ii) and (iii)
 (C) (i) and (iii) (D) (iii) and (iv)

[GATE 1996 : IISc Bangalore]

Q.3 Which one of the following regular expressions over $\{0, 1\}$ denotes the set of all strings not containing 100 as a substring?

- (A) $0^*(1+0)^*$ (B) 0^*1010^*
 (C) $0^*1^*01^*$ (D) $0^*(10+1)^*$

[GATE 1997 : IIT Madras]

Q.4 If the regular set A is represented by $A = (01+1)^*$ and the regular set 'B' is represented by $B = ((01)^*1^*)^*$, which of the following is true?

- (A) $A \subset B$
 (B) $B \subset A$
 (C) A and B are incomparable
 (D) $A = B$

[GATE 1998 : IIT Delhi]

Q.5 The string 1101 does not belong to the set represented by

- (A) $110^*(0+1)$
 (B) $1(0+1)^*101$
 (C) $(10)^*(01)^*(00+11)^*$
 (D) $(00+(11)^*0)^*$

[GATE 1998 : IIT Delhi]

- (B) $0^+(0+10)^*$
 (C) $(0+1)^*10(0+1)^*$
 (D) None of the above

[GATE 2003 : IIT Madras]

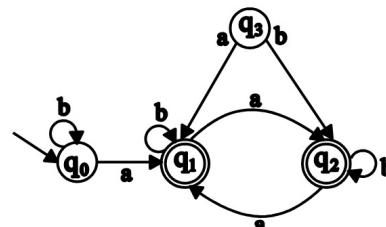
Q.8 Consider the regular language $L = (111+11111)^*$. The minimum number of states in any DFA accepting this language is

- (A) 3 (B) 5
 (C) 8 (D) 9

[GATE 2006 : IIT Kharagpur]

Common Data for Q.9 & Q.10 Questions

Consider the following finite state automaton



Q.9 The language accepted by this automaton is given by the regular expression

- (A) $b^*ab^*ab^*ab^*$ (B) $(a+b)^*$
 (C) $b^*a(a+b)^*$ (D) $b^*ab^*ab^*$

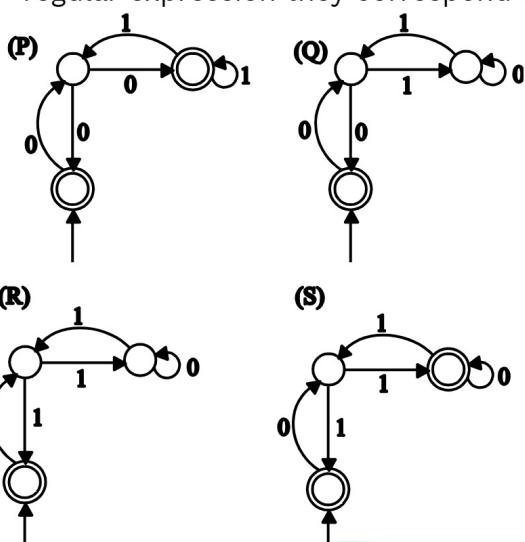
[GATE 2007 : IIT Kanpur]

Q.10 The minimum state automation equivalent to the above FSA has the following number of states

- (A) 1 (B) 2
 (C) 3 (D) 4

[GATE 2007 : IIT Kanpur]

Q.11 Match the following NFA's with the regular expression they correspond to



1. $\epsilon + 0(01^*1+00)^*01^*$
 2. $\epsilon + 0(10^*1+00)^*0$

Q.14 Consider the languages $L_1 = \emptyset$ and $L_2 = \{a\}$. Which one of the following represents $L_1 L_2^* \cup L_1^* L_2$?

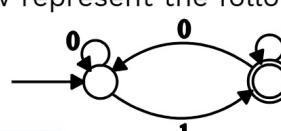
- (A) $\{\epsilon\}$ (B) \emptyset
 (C) a^* (D) $\{\epsilon, a\}$

[GATE 2013 : IIT Bombay]

Q.15 The length of the shortest string NOT in the language (over $\Sigma = \{a, b\}$) of the following regular expression is _____.

$$a^*b^*(ba)^*a^*$$

Q.16 Which of the regular expression given below represent the following DFA?



1. $0^*1(1+00^*1^*)^*$
 2. $0^*1^*1+11^*0^*1$
 3. $0^*1^*1+11^*0^*1$

3. $\varepsilon + 0(10*1+10)*1$
 4. $\varepsilon + 0(10*1+10)*10*$
 (A) $P-2, Q-1, R-3, S-4$
 (B) $P-1, Q-3, R-2, S-4$
 (C) $P-1, Q-2, R-3, S-4$
 (D) $P-3, Q-2, R-1, S-4$

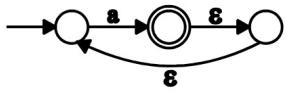
[GATE 2008 : IISc Bangalore]

- Q. 12** Let $L = \{w \in (0+1)^* | w \text{ has even number of } 1\text{'s}\}$, i.e. L is the set of all bit strings with even number of 1's. Which one of the regular expressions below represents L?
 (A) $(0*10^*)^*$ (B) $0^*(10^*10^*)^*$
 (C) $0^*(10^*1)^*0^*$ (D) $0^*1(10^*1)^*10^*$

[GATE 2010 : IIT Guwahati]

- Q. 13** What is the complement of the language accepted by the NFA shown below?

Assume $\Sigma = \{a\}$ and ε is the empty string.



- (A) ϕ (B) $\{\varepsilon\}$
 (C) a^* (D) $\{a, \varepsilon\}$

corresponding to the regular expression $(0+1)^* (10)$ is _____. 

[GATE 2015 : IIT Kanpur]

- Q. 20** Consider the alphabet $\Sigma = \{0,1\}$, the null/empty string λ and the set of strings X_0 , X_1 , and X_2 generated by the corresponding non-terminals of a regular grammar. X_0 , X_1 , and X_2 are related as follows.

$$X_0 = 1X_1$$

$$X_1 = 0X_1 + 1X_2$$

$$X_2 = 0X_1 + \{\lambda\}$$

Which one of the following choices precisely represents the strings in X_0 ?

- (A) $10(0^* + (10)^*)1$
 (B) $10(0^* + (10^*))^*1$
 (C) $1(0+10)^*1$
 (D) $10(0+10)^*1 + 110(0+10)^*1$

[GATE 2015 : IIT Kanpur]

- Q. 21** Which one of the following regular expressions represents the language : *the set of all binary strings having two*

3. $(0+1)^*1$
 (A) 1 and 2 only (B) 1 and 3 only
 (C) 2 and 3 only (D) 1, 2, and 3

[GATE 2014 : IIT Kharagpur]

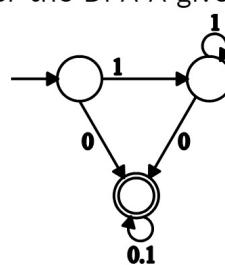
- Q. 17** Let $L_1 = \{w \in \{0,1\}^* | w \text{ has at least as many occurrences of (110)'s as (011)'s}\}$. Let $L_2 = \{w \in \{0,1\}^* | w \text{ has at least as many occurrences of (000)'s as (111)'s}\}$. Which one of the following is TRUE?
 (A) L_1 is regular but not L_2
 (B) L_2 is regular but not L_1
 (C) Both L_1 and L_2 are regular.
 (D) Neither L_1 nor L_2 are regular

[GATE 2014 : IIT Kharagpur]

- Q. 18** Let L be the language represented by the regular expression $\Sigma^*0011\Sigma^*$ where $\Sigma = \{0,1\}$. What is the minimum number of states in a DFA that recognizes \bar{L} (complement of L)?
 (A) 4 (B) 5
 (C) 6 (D) 8

[GATE 2015 : IIT Kanpur]

- Q. 19** The number of states in the minimal deterministic finite automaton



- Q. 24** Consider the DFA A given below.

Which of the following are FALSE?

1. Complement of $L(A)$ is context-free
 2. $L(A) = L((11^*0+0)(0+1)^*0^*1^*)$
 3. For the language accepted by A, A is the minimal DFA.
 4. A accepts all strings over $\{0, 1\}$ of length at least 2.
- (A) 1 and 3 only (B) 2 and 4 only
 (C) 2 and 3 only (D) 3 and 4 only

[GATE 2013 : IIT Bombay]

- Q. 25** Consider the following two statements:
- I. If all states of an NFA are accepting states then the language accepted by the NFA is Σ^* .
 - II. There exists a regular language A