Assignment - I

Ans 1:- Asymptotic notations are languages that allow us to analyze an algorithm running time by identifying its behaviour as the input size of algorithm.

Types:-

(a) Big O: It is commonly used for worst case, and gives upper bound for the growth rate of runtime of algorithm.
Ex:- Big O notation for linear search is $O(n)$

(b) Big Omega: It is notation used for best can complexity, it provides as with an asymptotic lower bound.
Ex:- Big Omega of linear search is $\Omega(1)$

(c) Theta: It is used for right bound on the growth rate of runtime of algo.
Ex:- Theta of linear search is $\Theta(n)$.

(d) Small Omega: To denote lower bound (that is not asymptotic right).

Ans 2:-
```
for (i = 1 to n)
{ i = i + 2; }
```
$\Rightarrow O(\log n)$

Ans 3:- $T(n) = 3T(n-1)$

$T(1) = 1$

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

$T(3) = 3T(2) = 9$

$T(4) = 3T(3) = 27$

⋮

$T(n) = (n-1)^3$

Time complexity → $O(3^n)$

Ans 4:- $T(n) = 2(T(n-1)-1)$

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

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

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

$T(n) \quad 8T(n-3)-4-2-1$

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

$T(n) = 16T(n-4)-8-4-2-1$

$T(n) = 2^k \text{ ---- } 2^3 - 2^2 - 2^1 - 2^0$

$= O(1)$

Ans 5:-

S	i
1	1
3	2
6	3
10	4

$O(\sqrt{n})$

Ans 6:- $i * i = n$

$i^2 = n$

$i = \sqrt{n}$

$O(\sqrt{n})$

Ans 7:- $O(n \log^2 n)$

Ans 8:- Total $T = O(n \log n)$

Ans 10:- n^k is $O(c^k)$ as for example of :- when we take $n=2, k=2, c=2$

Then $2^2 \leq 2^2$ so c^k is upper limit of n^k.

Ans 11:

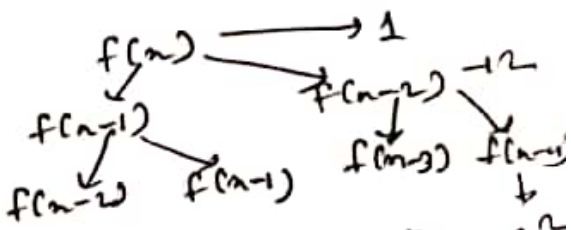
j = 1	i = 0
1	1
2	3
3	6
4	10

The series is nearly dependent on i as 2^i

So $O(2^n)$

Ans 12: Space complexity

$= O(n)$ as clear call of $(n-1)$



$= 2^n$

time complexity $= O(2^$

Ans 13:- $n \log n$

```
for (i=0; i<n; i++)
    for (j=0; j<n; j=j*
        c++;
```

n^3

```
for (i=0; i<n; i++)
for (j=0; j<n; j++)
for (k=0; k<n;
        k++)
    c++;
```

log (log n)

```
int funct (int n) {
    if (n==1)
        return n;
else
return func(√n) +
    func(√n);
```

Ans 14:- $T(n) = T\left(\frac{n}{2}\right) + T\left(\frac{n}{4}\right) + cn^2$

Using master's

$a = 2, \; b = 2$

$c = 1$

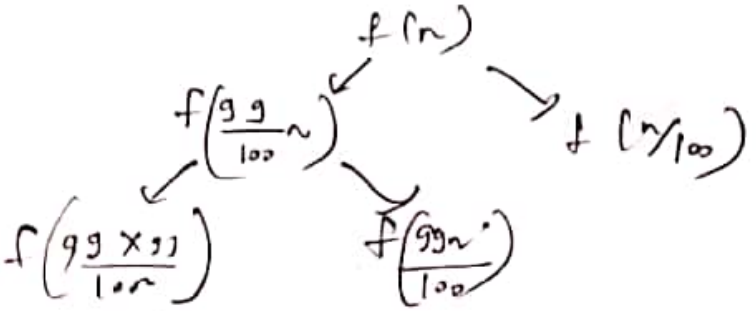
$f(n) > n^c$ & $n^2 > 1$

$O(n^2)$

Ans 15: $O(n\sqrt{n})$

Ans 16:- $O(\log \log n)$

Ans 17: $T(n) = T\left(\frac{99}{100}n\right) + T\left(\frac{n}{100}\right)$



$= O(\log n)$

Ans 18:- a) $100 < \log\log n < \log n < \sqrt{n} < n \log(1) < n \log n \, n < n^2 < 2^n < 2^{2n} < 4^n < n!$

b) $1 < \log\log n < \sqrt{\log n} < \log^2 n < \log n < 2\log_2 n < n < 2n < 4n < n^2 < n! < 2^n < (n)^n 2^n!$

c) $96 < \log_2 n < \log_{2n} < \log_{8n} < \log n! < n\log n < n\log_2 n < 8n^2 < 2n^3 < 8^{2n} < n!$

Ans 19:
```
linear (arr, key) {
    for (int i=0; i<n; i++)
        if (arr[i] == key)
            return i;
    return -1;
}
```

Ans 20:
```
Ins (arr, n) {
    if (n <= 1) return;
    recursively for n-1 elements
    Insert Sor (arr...
}
```

; Pick last element arr[i] & Ins [i] into sorted

Iterations:-

```
Insert (arr, n) {
    for (i = 1; i<n; i++)
    {
     Pick arr(i) & insert into arr [0, --- i-1]
    }
```

	Stable	Inplace	Online
Bubble Sort	✓	✓	✗
Selection "	✗	✓	✗
Insertion "	✓	✓	✓

Ans 22:

	Best	Avg	Worst
Bubble	$O(n^2)$	$O(n^2)$	$O(n^2)$
Selection	$O(n^2)$	$O(n^2)$	$O(n^2)$
Insertion	$O(n)$	$O(n)$	$O(n^2)$

Ans 23:- Recursive:-

```
Binary (arr, l, r, key) {
If (l<r) {
    mid = l + (r-l)/2;
 if (arr[mid] == key) ret 1;
 if (key < arr mid))
 Binary (l, mid-1, key);
else
    Binary (mid+1, r, key)
}
```

Iterative:-

```
while (l<r)
{
  mid = l + (r-l)/2
if (arr[mid] == key) return 1;
  if (key < arr[mid])
      r = mid-1;
  else  l = mid+1;
}
```

Ans 24:

$T(n) = T(n/2) + 1$