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Section :- E

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Sheet :- Test - 4

Ans-1 $T(n) = 3T(n/2) + n^2$

$a = 3 \quad b = 2$

$k = \log_2 3 = 1.58$

$n^2 > n^{1.58}$

$\therefore \underline{\Theta(n^2)}$

Ans-2 $T(n) = 4T(n/2) + n^2$

$k = \log_2 4 = 2$

$n^2 = n^2$

$\therefore \underline{\Theta(n^2 \log n)}$

Ans-3 $T(n) = T(n/2) + 2^n$

here $f(n)$ is not a polynomial

$\therefore$ we can not apply Master theorem.

Ans-4 $T(n) = 2^n T(n/2) + n^n$

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Here, this recurrence relation can't be solved using Master's method.

Ans- 5 $T(n) = 16T(n/4) + n$

$k = \log_4 16 = 2$

$n^2 > n$

$\therefore \Theta(n^2)$

Ans - 6 $T(n) = 2T(n/2) + n \log n$

$\therefore$ Case $k = 1$ (by normal Master theorem)

Now by using extended Master's theorem.

$T(n) = aT(n/b) + \Theta(n^k \log^p n)$

$a = b^k$. $2 = 2$

$T(n) = \Theta(n^{\log_2 2} \log^{1+1} n)$

$\Theta(n \log^2 n)$

Ans-7 $T(n) = 2T(n/2) + n \log^{-1} n$

using extended Master's theorem.

$T(n) = aT(n/b) + \Theta(n^k \log^p n)$

$a = 2$, $b = 2$. $k = 1$, $p = -1$

$p = -1$

$\therefore T(n) = \theta(n^{\log_2 2} \log\log n)$

$= \theta(n \log\log n)$

Ans- 8 $T(n) = 2T(n/4) + n^{0.51}$

$a = 2, \; b = 4$

case $k = \log_4 2 = 0.5$

$n^{0.5} < n^{0.51}$

$\therefore O(n^{0.51})$

Ans- 9 $T(n) = 0.5T(n/2) + n^{-1}$

As $a < 1$, $\therefore$ Master's theorem's can not apply here.

Ans-10 $T(n) = 16T(n/4) + n!$

$k = \log_4 16 = 2$

$n^2 < n!$

$\therefore \underline{O(n!)}$

Ans-11 $T(n) = 4T(n/2) + \log n$

here. $a = 4, \; b = 2, \; k = 0, \; p = 1$

$\therefore$ using Extended Master's theorem.

$T(n) = aT(n/b) + \Theta(n^k \log^p n)$

$a > b^k$

$4 > 2^0$

$\therefore \Theta(n^{\log_2 4})$

$\therefore O(n^2)$

Ans-12 $T(n) = \sqrt{n}\, T(n/2) + \log n$

here a is not constant, so Master theorem's can not apply here.

Ans-13 $T(n) = 3T(n/2) + n$

$k = \log_2 3 = 1.58$

$n^{1.58} > n$

$= \Theta(n^{1.58})$

Ans-14 $T(n) = 3T(n/3) + \sqrt{n}$

$K = \log_3 3 = 1$

$n^1 > \sqrt{n}$

$= O(n)$

Ans-15 $T(n) = 4T(n/2) + n$

$k = \log_2 4 = 2$

$n^2 > n$

$\therefore \Theta(n^2)$

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Ans-16 $T(n) = 3T(n/4) + n \log n$

using extend Master's theorem

$T(n) = a\,T(n/b) + \Theta(n^k \log^p n)$

here $a = 3$, $b = 4$, $k = 1$, $p = 1$

$a < b^k$
$3 < 4^k$

$p >= 0$

$\therefore T(n) = \Theta(n^k \log^p n)$

$= \Theta(n \log n)$

Ans-17 $T(n) = 3T(n/3)$

$c = \log_3 3 = 1$

$n^1 = n$

$\therefore \Theta(n \log n)$

Ans-18 $T(n) = 6T(n/3) + n^2 \log n$

using extended Master's theorem

$T(n) = a(T(n/b)) + \Theta(n^k \log^p n)$

$a = 6$, $b = 3$, $k = 2$, $p = 1$

$a < b^k$
$6 < 3^2$

$p >= 0$

$\therefore T(n) = \Theta(n^k \log^p n)$

$= \Theta(n^2 \log n)$

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Ans-19 $T(n) = 4T(n/2) + n \log^{-1} n$

using Master theorem's extended.

$T(n) = aT(n/b) + \Theta(n^k \log^p n)$

$a = 4,\ b = 2,\ k = 1,\ p = 1$

$a > b^k$

$4 > 2^1$

$\therefore T(n) = \Theta(n^{\log_2 4})$

$= \Theta(n^2)$

Ans-20 $T(n) = 64T(n/8) - n^2 \log n$

As $f(n)$ is negative.

$\therefore$ we can not apply Master's theorem.

Ans-21 $T(n) = 7T(n/3) + n^2$

using Master theorem

$k = \log_3 7 = 1.77$

$n^{1.77} < n^2$

$\therefore \underline{\Theta(n^2)}$

Ans-22

here, we can not apply Master's theorem.

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