MCQ Chapter 4 – Mathematical Analysis of Recursive Algorithm

1. The term used to describe the number of preceding terms used for computing the present term of a sequence
   a. Rank of a recurrence equation
   b. Index of a recurrence equation
   c. Order of a recurrence equation
   d. Degree of a recurrence equation

   Ans: c) Order of a recurrence equation
2. Which method starts from the last term of a sequence and moves towards the base condition by repeatedly substituting the RHS of a recurrence equation?
   a. Forward substitution
   b. Backward substitution
   c. Recursive substitution
   d. Base substitution

   Ans: b) Backward substitution
3. How are the terms of the recurrence tree expanded?
   a. Linearly
   b. In a tree-like manner
   c. Recursively
   d. Geometrically

   Ans: b) In a tree-like manner
4. Which method is used to solve a linear recurrence relation with constant coefficients?
   a. Ladder method
   b. Difference method
   c. Summation method
   d. Smoothness rule

   Ans: b) Difference method
5. What is domain transformation used for in relation to recurrence equations?
   a. Solving with recursion
   b. Solving with regular methods
   c. Using complex numbers
   d. Applying mathematical induction

   Ans: b) Solving with regular methods
6. How can conditional asymptotics be achieved in recurrence analysis?
   a. Mathematical induction
   b. Applying smoothness rule
   c. Divide and conquer
   d. Backward substitution

   Ans: b) Applying smoothness rule
7. What is the form of a divide and conquer recurrence that involves a non-linear combination of input?
   a. T(n) = aT(n/b) + f(n)
   b. T(n) = T(n-1) + f(n)
   c. T(n) = T(n/2) + f(n)
   d. T(n) = aT(a/b) + f(n)

Ans: d) T(n) = aT(a/b) + f(n)

8. What is the solution for $T(n) = 2T\left(\frac{n}{2}\right) + n$?
   a. $\theta(n \log n)$
   b. $\theta(2^n \log n)$
   c. $\theta(lg\, n)$
   d. $\theta(2^n)$

   Ans: **a. $\boldsymbol{\theta(n \log n)}$**

9. What is the solution for $t_n = \begin{cases} 1 & n = 1 \\ 8T\left(\frac{n}{2}\right) & n > 1 \end{cases}$
   a. $\theta(n^2)$
   b. $\theta(n^3 + n)$
   c. $\theta(n^3)$
   d. $\theta(n)$

   Ans: $\theta(n^3)$

10. What is the solution for $t_n = t_{n-1} + 6n$?
    a. $O(n^2)$
    b. $\theta(1)$
    c. $O(1)$
    d. $\omega(n^2)$

    Ans: **a. $\boldsymbol{O(n^2)}$**

11. What is the solution for $t_n - 3t_{n-1} + 2t_{n-2} = 0$ for $n > 0$ where $t_0 = 0$ and $t_1 = 1$?
    a. $2^n - 1^n$
    b. 2^n
    c. 5^n
    d. 2^{n-1}

    Ans: **a. $\boldsymbol{2^n - 1^n}$**

12. What is the solution for $t_n = 7t_{n-1}$ where $t_0 = 1$?
    a. 7^n
    b. 5^n
    c. 2^n
    d. $7^n + 5$

    Ans: **a. $\boldsymbol{7^n}$**

13. What is the solution for $t_n - 6t_{n-1} + 11t_{n-2} - 6t_{n-3} = 0$?
    a. $t_n = c_1 1^n + c_2 2^n + c_3 3^n$
    b. $t_n = (c_1 + c_2 n)\, 2^n + c_3 3^n$
    c. $t_n = c_1 1^n + c_2 2^n$
    d. $t_n = c_1 1^n + c_2 2^{n+1} + c_3 3^n$

    Ans: **a. $\boldsymbol{t_n = c_1 1^n + c_2 2^n + c_3 3^n}$**

14. What is the solution for $T(n) = 8T\left(\frac{n}{2}\right) + n^2$?
    a. $\theta(n^3)$
    b. $\theta(n^2)$
    c. $\theta(n)$
    d. $\theta(1)$

    Ans: $\theta(n^3)$

15. What is the domain transformed equation of $T(n) = T\left(\frac{n}{2}\right) + n$?
    a. $T(k) = T(k-1) + 2^k$
    b. $T(k) = T(k-2) + n$
    c. $T(k) = T(k-1) + n^k$
    d. $T(k) = T(k/2) + k$

    Ans: **a.** $\boldsymbol{T(k) = T(k-1) + 2^k}$
16. What is the solution for $T(n) = 2T(\sqrt{n})$?
    a. $T(n) = n$
    b. $T(n) = n\sqrt{n}$
    c. $T(n) = n^2$
    d. $T(n) = nT(n-1)$

    Ans: **a.** $\boldsymbol{T(n) = n}$
17. In which of the following equation, the master theorem applies?
    a. $T(n) = 3^n T\left(\frac{n}{2}\right) + n^3$
    b. $T(n) = 4T\left(\frac{n}{4}\right) + \frac{n}{log\, n}$
    c. $T(n) = 2T\left(\frac{n}{2}\right) + n$
    d. $T(n) = T\left(\frac{n}{4}\right) - n^5$

    Ans: c. $T(n) = 2T\left(\frac{n}{2}\right) + n$
18. Which of the following technique is not part of solving the Recurrence equation?
    a. Substitution Method
    b. Master Theorem
    c. Polynomial Reduction Method
    d. Elimination Method

    Ans: **d. Elimination Method**
19. _____ is a technique which uses the difference between the terms for solving an equation.
    a. Telescoping
    b. Cook-Book
    c. Divide and Conquer Method
    d. Recurrence Tree

    Ans: **a. Telescoping**
20. What is the solution for $t_n - t_{n-1} - 6t_{n-2} = 0$ and $t_0 = t_1 = 1$
    a. $2^n + 3^n$
    b. $\frac{3^{n+1} + (-1)^n 2^{n+1}}{5^n}$

c. $3^n + 2^{n+1}$

d. $3^n + 5^n$

Ans: b. $\frac{3^{n+1}+(-1)^n 2^{n+1}}{5^n}$