

23BCSC04 Discrete Structures

Course Outcomes:

- CO1: Understand the notion of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem solving.
- CO2: Understand the basics of combinatorics, and be able to apply the methods from these subjects in problem solving.
- CO3: Be able to use effectively algebraic techniques to analyse basic discrete structures and algorithms.
- CO4: Understand asymptotic notation, its significance, and be able to use it to analyse asymptotic performance for some basic algorithmic examples.
- CO5: Understand some basic properties of graphs and trees and related discrete structures, and be able to relate these to practical examples.

Part A

10 x 1 = 10

Choose the Correct Answer

1. What is the main characteristic that distinguishes a finite set from an infinite set? CO1K1
a. Size b. Elements c. Countability d. Membership
2. In a group of 5 people, how many different ways can they arrange themselves in a line? CO1K2
a. 5 b. 10 c. 20 d. 120
3. Which asymptotic notation represents an upper bound on an algorithm's running time? CO2K1
a. Θ (Theta) notation b. O (Big O) notation
c. Ω (Omega) notation d. o (Little O) notation
4. What is the sum of the first n natural numbers using the summation notation? CO2K2
a. $n(n+1)/2$ b. n^2 c. $n/2$ d. $2n$
5. What is the solution to the recurrence relation $T(n) = T(n-1) + 3$ with the base case $T(1) = 2$? CO3K2
a. $T(n) = 3n-1$ b. $T(n) = 3n-2$ c. $T(n) = 3n+1$ d. $T(n) = 3n$
6. Solving the recurrence by the sum of the multiples of previous terms is called CO3K2
a. Degree b. Linear c. Homogenous d. Coefficient
7. Let G be a simple undirected planar graph on 10 vertices with 15 edges. If G is a CO4K1
connected graph, then the number of bounded faces in any embedding of G on the plane is equal to
a. 6 b. 5 c. 4 d. 3
8. The minimum number of colours that is sufficient to vertex-colour any planar graph is ____ CO4K2
a. 2 b. 5 c. 4 d. 3
9. In a tree, a node with an out degree greater than or equal to one is considered an ____ node? CO5K1
a. Outer b. Internal c. External d. Terminal
10. The act of traversing a tree involves visiting all its ____? CO5K1
a. Nodes b. Edges c. Vertices d. Endpoints

Part B

5 x 6 = 30

Answer ALL questions

Each answer should not exceed 400 words or two pages

- 11.a. (i) Define Reflexive Closure, Symmetric Closure and Transitive Closure (ii) Let R CO1K4
be the relation on the set $\{0, 1, 2, 3\}$ containing the ordered pairs $(0,1), (1,1), (1,2), (2,0), (2,2)$ and $(3,0)$. Find the reflexive closure of R , symmetric closure of R . (iii)
Let R be the relation on the set $\{1, 2, 3\}$ containing the ordered pairs $(1,1), (2,3)$
and $(3,1)$. Find the transitive closure of R .

- (or)
- 11.b. (i) Among 100 people, how many of them are guaranteed to be born in the same month? CO1K3
(ii) How many cards must be selected from a standard deck of 52 cards to guarantee that at least three cards of the same suit are chosen? (iii) How many cards must be selected from a standard deck of 52 cards to guarantee that at least three hearts are selected?
- 12.a. Explain the concept of Asymptotic notations with suitable examples. CO2K2
(or)
- 12.b. Write notes on Bounding summations. CO2K3
- 13.a. Find the generating functions for the below sequences: (i) 1,1,1,... (ii) 1,1,1,1,1,1,0,0 CO3K2
(iii) 1,3,3,1,0,0 (iv) 1, a, a², a³, ... (v) 1,3,9,27,... (vi) 1,2,3,4,... (vii) 0,1,2,3,...
(viii) 0,0,0,1,2,3,... (ix) 0,0,0,1,1,1,... (x) 1,1,0,1,1,1,... (xi) 1,0,-1,0,1,0,-1,...
(xii) 2,-2, 2,-2,...
- (or)
- 13.b. Find the time complexity of the recurrence relation using substitution method CO3K4
 $T(n) = 2T(n/2) + n$ if $n > 1$ and $T(n) = 1$ if $n = 1$.
- 14.a. Describe the concept of connectivity in Graph Theory. CO4K1
(or)
- 14.b. Write notes on Graph Coloring. CO4K1
- 15.a. Define Well Formed Formula, the rules for well formed formula and give few CO5K2
examples for well formed formula and not well formed formula.
(or)
- 15.b. Detail on the basic terminologies and properties of trees. CO5K2

Part C

5 x 12 = 60

Answer ALL questions

Each answer should not exceed 800 words or four pages

- 16.a. (i) Define a relation with a suitable example. (ii) Explain the properties of binary CO1K2
relations with suitable examples.
(or)
- 16.b. A survey on a sample of 25 new cars being sold by a local auto dealer was conducted CO1K3
to see which of the 3 popular options AC (A), Radio (R) & Power Window (W) are
already installed. The survey found that 15 had A, 12 had R, 11 had W, 5 had A & W,
9 had A & R, 4 had R & W, 3 had all options. Find i) Car with atleast one option
ii) No option iii) Only A & R, no W iv) Only A & W, no R, v) Only R & W, no A,
vi) Only A vii) Only R viii) Only W ix) Only one option.
- 17.a. Explain the techniques of Approximation by integrals with examples. CO2K2
(or)
- 17.b. (i) List the summation formulas and properties. CO2K3
(ii) Find the sum of 10 first natural numbers greater than 5, using the summation formula.
(iii) Find the sum of all even numbers from 1 to 100
(iv) Simplify and evaluate $\sum_{x=1}^n (4+x)$.
(v) Find the value of $\sum_{i=1}^n (3 - 2i)$ using the summation formulas.
- 18.a. Solve the following recurrence relations. (i) $a_n = 4a_{n-1} + 5a_{n-2} + 7^n$ where CO3K4
 $a_1 = 2$ and $a_2 = 6$, (ii) $a_n = 6a_{n-1} - 11a_{n-2} + 6a_{n-3}$ where $a_0 = 2, a_1 = 5, a_2 = 15$
(or)
- 18.b. Write about the application of master theorem in binary search and find its CO3K2
time complexity.
- 19.a. Explain the concept of Graph Isomorphism with examples. CO4K2
(or)
- 19.b. Detail on the Euler and Hamiltonian Circuits with suitable examples. CO4K2