United International University
Department of Computer Science and Engineering

CSE 2213: Discrete Mathematics Final : Fall 2022

Total Marks: 40 Time: 2 hour

Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

Answer all the questions. Numbers to the right of the questions denote their marks.

1. Use mathematical induction to prove the following summation formula for all positive integer values of n: (4)

$$1^3 + 2^3 + 3^3 + ... + n^3 = \left(\frac{n(n+1)}{2}\right)^2$$

2. Consider the following tree in Figure 1.

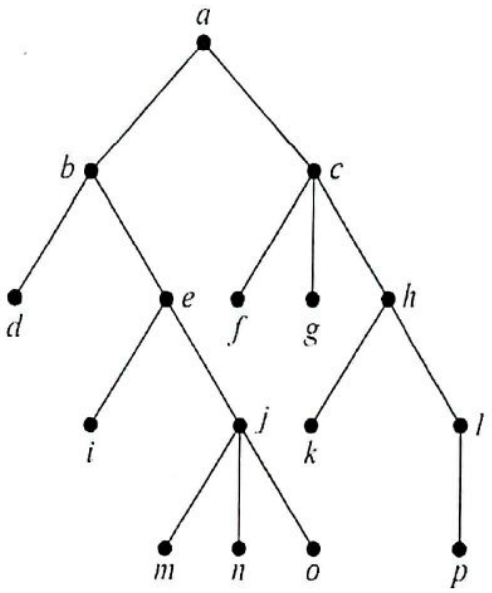

Figure 1: Figure for Question 2

(a) Find the preorder and postorder traversal of the tree in Figure 1. (4)

(b) How many edges does a full binary tree with 1000 internal vertices have? (1)

3. (a) Considering the dictionary order, draw a binary search tree from the following entries: John, Leilani, Delicia, Florencio, Arthur, Jane, Johnson. (3)

(b) Draw an ordered rooted tree (T) from the following expression: $(((x + y)\%2) + ((x - 4)/3))) - (x * 4 + 2)$. (2)

(c) Find the prefix expression from the tree T. (2)

4. Consider the graph in Figure 2.

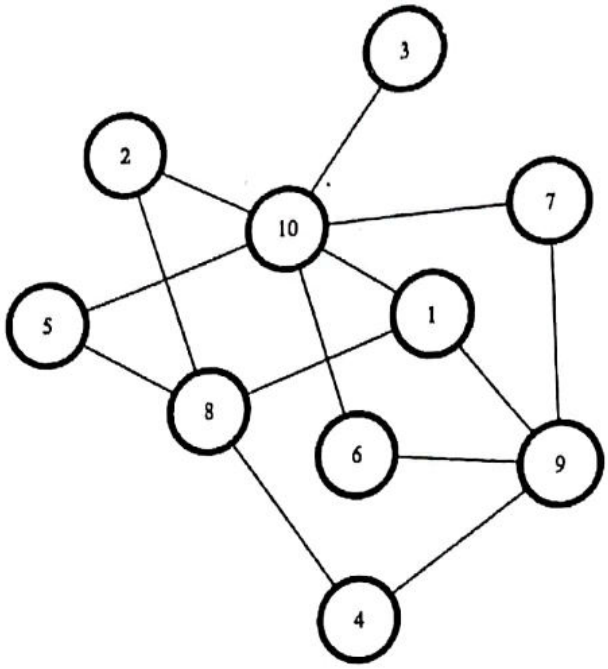

Figure 2: Figure for Question 4

(a) Find out if the graph is bipartite or not using *two coloring* method. If the graph is bipartite, find the bipartite sets. (4)

(b) Represent the graph using (4)
   i. Adjacency Matrix
   ii. Adjacency List

5. Consider the graph in **Figure 3**.

(a) Find out the in-degree and out-degree of each vertices from **Figure 3**. (2)

(b) Show that the **Handshaking theorem** is preserved in the graph from **Figure 3**. (2)

(c) Convert the graph to an undirected graph. Then find the incidence matrix of that graph. (4)

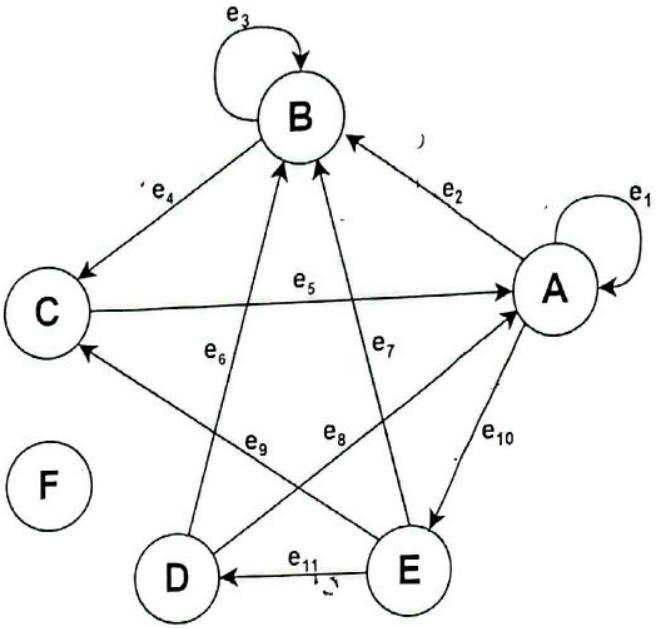

Figure 3: Figure for Question 5

6. (a) How many cards must be selected from a deck of 52 standard playing cards to guarantee that at least a **King**, a **Queen** and a **Red** card is picked? Explain with proper reasoning. (2)

   (b) In how many ways can the word EXAMINATION be arranged such that the word starts with an N, and the letters EX always stays together in any order? (2)

   (c) How many ways can UIU make a committee of 7 faculties from 7 **CS Faculties** and 7 **Math Faculties** so that the number of CS Faculties always remains **more** than the number of Math Faculties. The committee must contain at least one faculty from both departments. (2)

   (d) Assume that **Vowel Strings** are the strings having vowels (**A E I O U**) only. How many vowel strings of length 4 or less can you build that begin and end with the same vowel? (Do not consider empty strings) (2)