



**United International University (UIU)**  
 Dept. of Computer Science & Engineering (CSE)

**Final: Spring - 2023**

Course: CSE 2213 Name: Discrete Mathematics

Marks: 40, Time: 2 hours

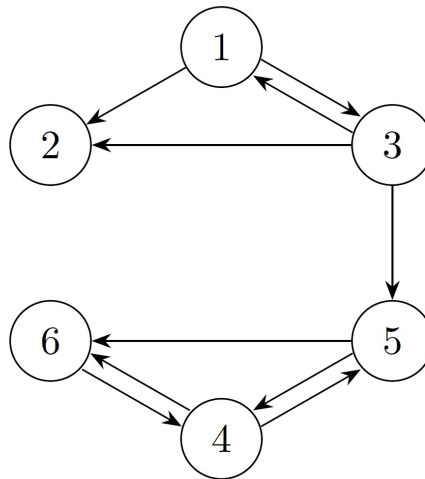
Figures in the right-hand margin indicate full marks.

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

**There are 3 pages in this question paper**

1. a) i) Write the Adjacency Matrix of the graph in the Figure 1

[2+2]



**Figure 1: Graph for Question 1(a)(i)**

- ii) The following matrix is the Incidence Matrix of an undirected graph. Draw the graph from the matrix. Indicate the names of the vertices and edges in your graph.

|   | a | b | c | d | e | f | g | h | i | j | k | l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| B | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| D | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| F | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| G | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |

- b) i) Determine whether the graph in Figure 2 is bipartite or not using graph coloring. If the graph is bipartite, show it in bipartite form.

[3+2]

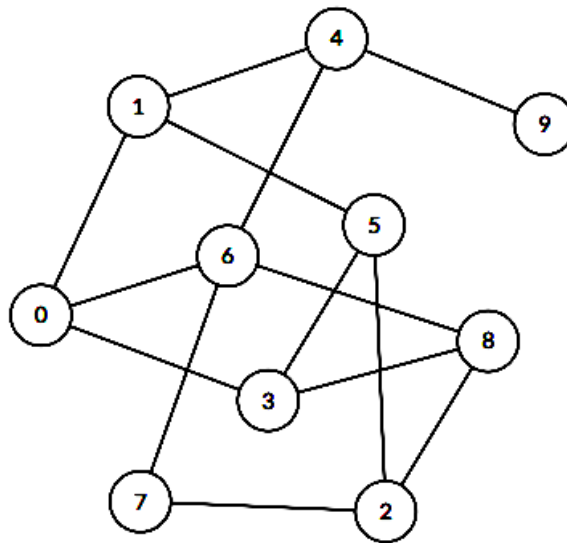
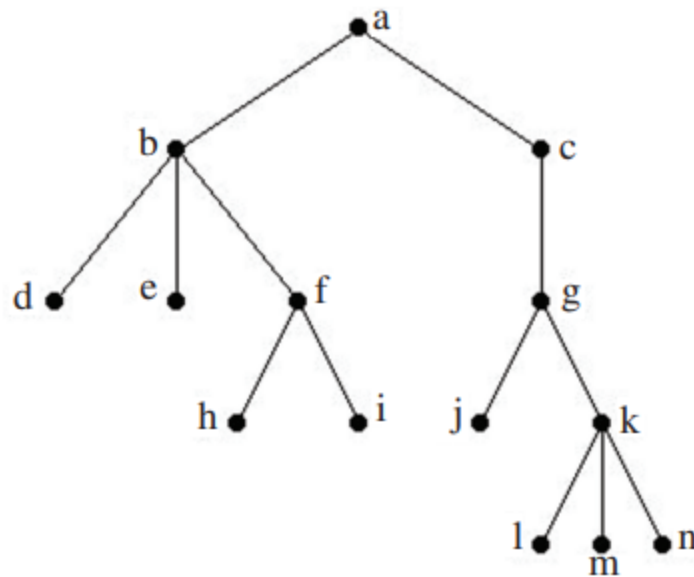


Figure 2: Graph for Question 1(b)

- ii) Prove that the graph in Figure 2 follows **Handshaking Theorem**.
- c) i) What is the maximum number of edges in a simple undirected graph with 7 vertices? [2+2+2]  
 ii) Consider a simple graph with 6 vertices and 10 edges. One of its vertices has degree 4, two of them have degree 3 and two of them have degree 2. Is the above description valid? Give an explanation for your answer.  
 iii) Draw  $W_7$ ,  $K_{4,4}$ ,  $C_6$  and  $K_5$ .
2. a) Consider the following list of numbers: [4+1+3]  
 8, 3, 10, 1, 6, 14, 4, 7  
 Now answer the following questions.  
 i) Construct a binary search tree using the numbers shown above.  
 ii) Determine whether the tree in **Question 2(a)(i)** is balanced or not.  
 iii) Provide the preorder traversal of the tree found in **Question 2(a)(i)**
- b) Consider the tree in Figure 3 and answer the following questions. [4x1=4]



**Figure 3: Tree for Question 2(b)**

- i) Determine the height of the tree.
- ii) Write down the ancestor of vertex m.
- iii) If the given tree is a p-ary tree, then what is the value of p?
- iv) Draw the subtree rooted at vertex e.

3. a) Use induction to show that for all positive integers  $n$ . [5]

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

4. a) The students of your class are arranging a raffle draw and forty five tickets, numbered 1, 2, 3, . . . ,45 are made for each student to draw one ticket from. Four different prizes are awarded in this event, including a grand prize (a trip to Maldives).How many ways are there to award the prizes if students holding ticket number 10 and 17 are winners but students holding tickets 27,37 and 45 do not win prizes? [3]
- b) A factory stores their manufactured products in a warehouse. Storage bins in this warehouse are specified by their row, location in the row, and shelf. There are 50 rows, 85 horizontal locations in each row, and 5 shelves throughout the warehouse. What is the least number of products the factory can produce so that at least one bin contains four products? [2]
- c) Find out the number of four letter words that can be created using letters from the word 'EXAMINATION'. [3]