



# United International University

## Department of Computer Science and Engineering

CSE 2213/CSI 219: Discrete Mathematics

Final Examination : Spring 2024

Total Marks: 40 Time: 2 Hours

Answer all the 5 questions. Numbers to the right of the questions denote their marks.

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

1. Using Mathematical Induction, prove that for every positive integer  $n$ , [3]

$$1 \cdot 2 + 2 \cdot 3 + \dots + n(n+1) = \frac{n(n+1)(n+2)}{3}$$

2. (a) In a certain country, car number plates are formed by 4 digits from the set  $\{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ , followed by 3 letters from the English alphabet. However, there are some restrictions: [2]
- The number plate cannot start with the digits 1, 2, or 3.
  - The last letter in the number plate must be a vowel (a, e, i, o, u).

How many number plates can be formed under these conditions if neither the digits nor the letters are repeated?

- (b) In a game tournament, there are 15 players competing. Each player is assigned a unique team color from a pool of 6 colors (Red, Blue, Green, Yellow, Purple, Orange). How many players must be assigned team colors to ensure that at least two players have been assigned the same team color? [2]
- (c) A group of 8 students is planning to form a committee consisting of a president, a vice-president, and a secretary. Four of the students are male, and four are female. The restriction is that the president must be a female student, while the vice-president and secretary must be male students. How many different committees can be formed with the given restrictions? [3]

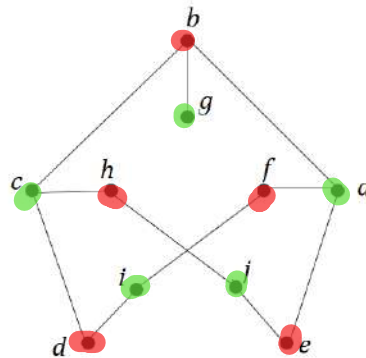


Figure 1: Graph for Question 3(a)

Yes

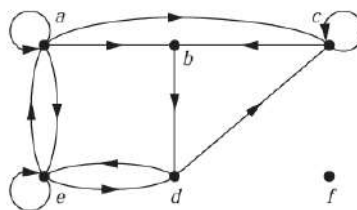
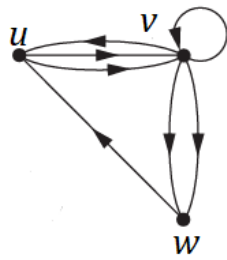
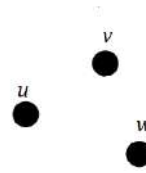


Figure 2: Graph for Question 3(b)

3. (a) Determine whether the graph in Figure 1 is bipartite or not, using the 2-coloring algorithm. If the graph is bipartite, redraw the graph in bipartite form. [3]
- (b) Does the graph in Figure 2 follow the Handshaking Theorem? Mathematically justify your answer. [3]
- (c) State, with short justification, whether the following statements are “True” or “False”. [1\*2=2]
- Figure 3(a) represents a directed pseudograph.



(a)



(b)

Figure 3: Graphs for Question 3 (c)

ii. Figure 3(b) represents a simple graph.

(d) Is it possible to draw a complete graph that is also a wheel? If yes, then draw the graph. Otherwise, explain your answer. [2]

4. (a) Find the incidence matrix of the graph in Figure 4. [2]

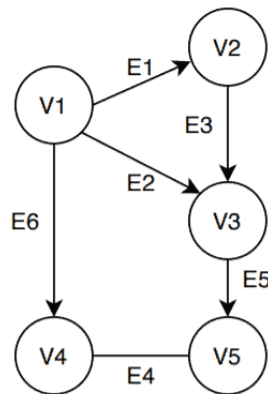


Figure 4: Graph for Question 4(a)

(b) Find the degree sequences of both the graphs in Figure 5. Determine whether the given pair of graphs is isomorphic. [4]

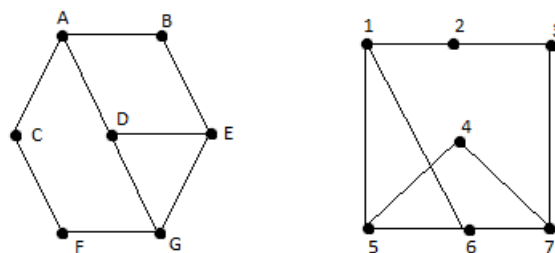


Figure 5: Graph for Question 4(b)

(c) Find out the strongly connected components of the graph in Figure 6. [4]

5. (a) Consider the Tree with root "a" in **Figure-7** and answer the following questions. [1+1+1+2 = 5]

i. Determine the height of the tree.

ii. If we consider this as x-ary tree then what is the value of x?

LOL

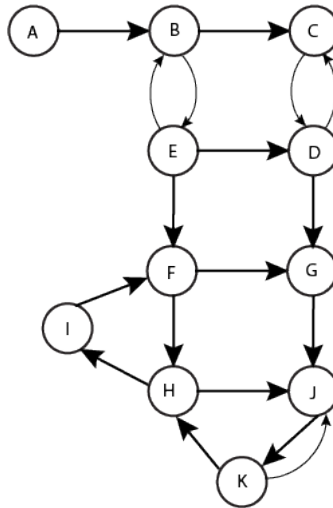


Figure 6: Graph for Question 4(c)

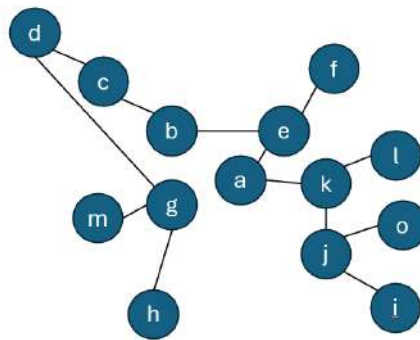


Figure 7: Tree for Question 5(a)

- iii. Can it be considered as balanced tree? justify your answer with short explanation.
  - iv. If this tree was a full x-ary tree with 40 leaves how many internal vertices would have been there?
- (b) Consider the following list of words: John, Ericsson, Erick, Zabir, Zaarib, Philip [2.5+2.5 = 5]  
 Now answer the following questions:
- i. Construct a binary search tree, inserting the given words one by one [draw only the final tree].
  - ii. Provide the inorder and the postorder traversals of the tree you constructed [you can write only the final results].