United International University
Department of Computer Science and Engineering

CSE 2213/CSI 219: Discrete Mathematics

Final Examination : Fall 2021

Total Marks: 40 Time: 2 hours

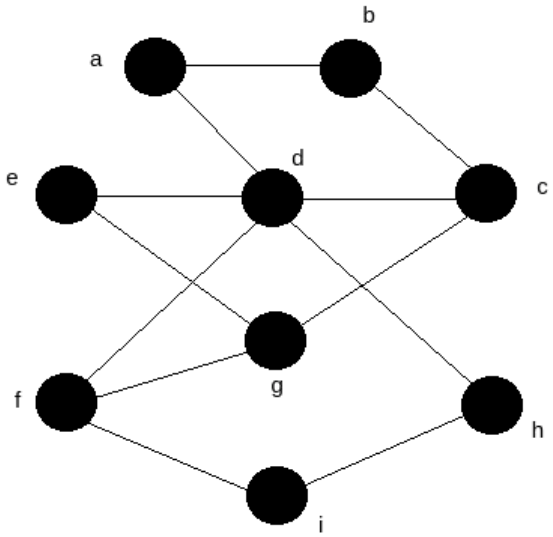
Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

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

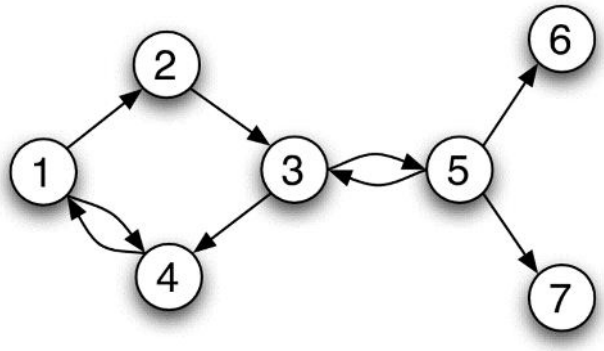
1. (a) Consider two complete graphs such that the number of vertices in the first graph is twice the number of vertices in the second graph. Moreover, the number of edges in the first graph is five times the number of edges in the second graph. Find the number of vertices and edges in both the graphs. [3]

   (b) You are given a graph $G(V, E)$, where $|V| = 12$. Among the vertices of G, 9 of them have degree 3 each. If each of the remaining 3 vertices have the same degree (say, x), what condition must you put on the value of x? [2]

   (c) Find out whether the following graph is bipartite or not. [3]



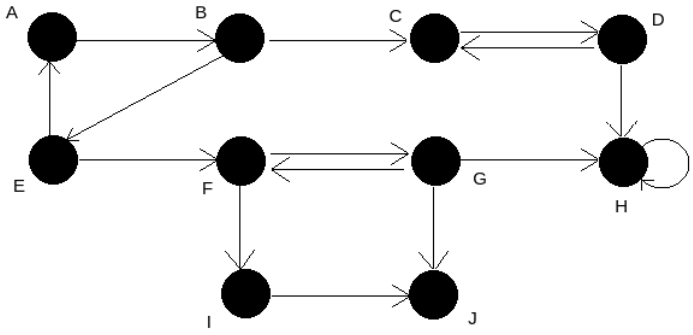
2. (a) Consider the following graph:



   i. Find the adjacency list of the given graph. [1.5]

   ii. Convert the graph into an undirected graph, and find the incidence matrix of the undirected graph. [1.5]

(b) Find out the strongly connected components of the following graph: [5]



3. (a) Draw the **BINARY TREE** that satisfies all of the following conditions. Letters $a - l$ represent vertices of the tree. [3]

i. The parent of b is e.
ii. d is the right child of e.
iii. The left and right children of d are f and a respectively.
iv. c and g are siblings (left and right respectively) and belong to the same level as a.
v. The ancestors of j (from bottom to top) are a, d and e.
vi. a does not have any right child.
vii. The descendants of g are i, l, k and h.
viii. l is a leaf and is the right child of g.
ix. i and h are leaves that belong to the highest level of the tree.

(b) Is the tree you have drawn in question 3(a) — [2]

i. A full binary tree? Explain your answer.
ii. A balanced tree? Explain your answer.

(c) A full m-ary tree has 271 vertices and 226 leaves. Calculate the number of edges, the number of internal vertices, and the maximum number of children that any internal vertex has. [3]

4. Consider the following values for question 4(a):

x = (LAST THREE DIGITS OF YOUR STUDENT ID % 10) + 70
y = (LAST THREE DIGITS OF YOUR STUDENT ID % 10) + 160

(a) Build a binary search tree for the indexes: 131, x, 140, 146, 148, 99, 156, y, 121, 118, 126, 111. What is the height of this BST? [3 + 1]

(b) Provide the prefix and the postfix notations of the following expression: [1.5 + 1.5]

$$(((P + Q) * R)/(P * Q)) + (R/S)$$

(c) Evaluate the value of the following prefix expression. [1]

$$- \quad + \quad 2 \quad * \quad 3 \quad 4 \quad / \quad 16 \quad \uparrow \quad 2 \quad 3$$

5. (a) Rahat has built up a mini library in his house. He has five shelves – one for Bangla novels, one for English novels, one for Maths and Science, one for current affairs, and one for comics. What is the minimum number of books Rahat must have if he has at least 150 books of the same category? [2]

(b) Grameenphone has recently been allowed to use the series 013 along with 017 in the moble phone numbers it can provide. There are a total of 11 digits in its mobile numbers, where each the remaining 8 digits are between 0 and 9. How many mobile phone numbers can Grameenphone provide? [3]

(c) Wordle is a new game where a player have to guess a five-letter word in six chances. In each chance, some letters are eliminated. Zinia was playing this game, and after five chances, she realized that the letters A, C, D, E, H, K, L, O, S, T, U and Y are eliminated. How many possible valid answers are remaining? [3]