



United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam. :: Trimester: Fall 2019

Course Code: CSE 2213, Course Title: DISCRETE MATHEMATICS

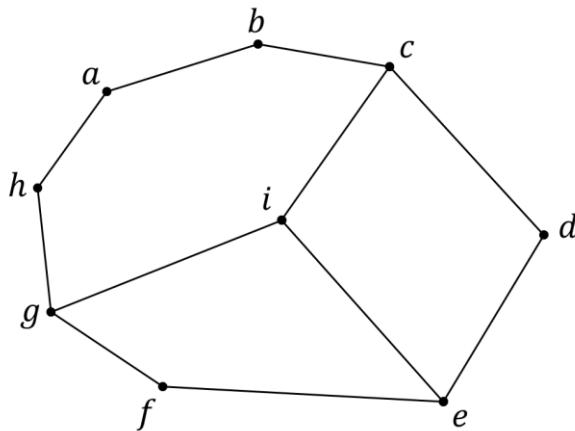
Total Marks: 40

Duration: 2 hr

Answer all the questions. Figures are in the right-hand margin indicate full marks.

Question 1

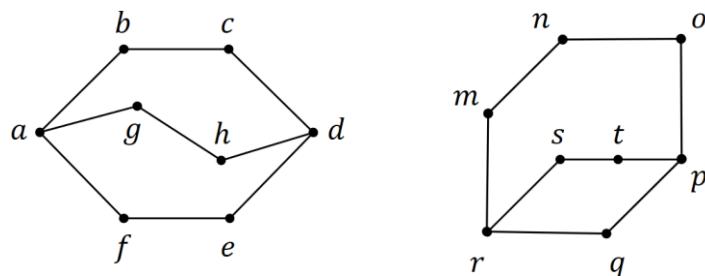
- a) Find out if the following graph is bipartite or not, using two coloring algorithm. If bipartite, show the graph in bipartite form. [4]



- b) Using handshaking theorem, show that a complete bipartite graph $K_{m,n}$ has mn edges. [2]
- c) An undirected graph has 9 vertices. 4 of them are of degree x , and the remaining 5 are of degree y . Which one among x and y must be even? Explain your answer using handshaking theorem. [2]

Question 2

- a) Find out if the following graphs are isomorphic. [3]

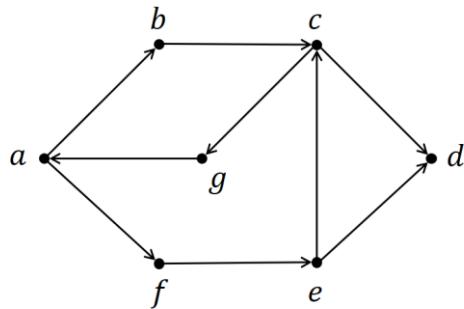


- b) The adjacency list of a graph is given here. Draw the graph. [3]

Vertex	Adjacency
a	b, e
b	a, c, d, f
c	d
d	e, f
e	a, d
f	b

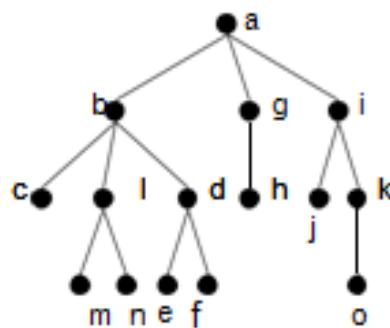
Question 2 (continued)

- c) Find out if the following graph is strongly connected. Explain your answer briefly. [2]



Question 3

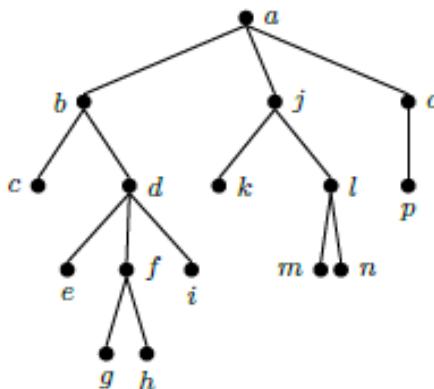
- a) How many leaves does a full 3-ary tree with 100 vertices have? [2]
- b) Find the preorder, inorder and postorder traversal orders of the following tree: [3]



- c) Evaluate the following expressions: [1.5+1.5]
- $+ - \uparrow 3 2 \uparrow 2 3 / 6 - 4 2$
 - $3 2 * 2 \uparrow 5 3 - 8 4 / * -$

Question 4

- a) Construct a binary search tree using the following integers: [3]
10, 5, 15, -5, 4, 25, 20
- b) How do you determine whether a rooted m-ary tree is balanced or not? Find out if the following tree (T) is balanced? [1+1]



T

- c) Find the following from the tree in Question 4(b). [1+1+1]
- Ancestors of h
 - parent of a
 - sub-tree rooted at o

Question 5

- a) The vehicle registration numbers in Dhaka city are formed as follow: first, these registration numbers contain the words “Dhaka Metro”, followed by the vehicle class (represented by one of 31 Bangla letters), vehicle series (a 2-digit number from 11 to 99), and the vehicle number (represented by a 4-digit number). How many registration numbers can be created in this way? [3]
- b) Among a set of 5 black balls and 3 red balls, how many selections of 5 balls can be made such that at least 3 of them are black balls. [3]
- c) How many 4 digit numbers that are divisible by 10 can be formed from the numbers 3, 5, 7, 8, 9, 0 such that no number repeats? [2]



United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam: : Trimester: Fall 2020

Course Code: CSE 2213, Course Title: DISCRETE MATHEMATICS

Time: 1 hour 15 min Total Marks: 25

Answer all the questions. Figures are 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.”

Question 1.

a)	Draw the undirected graph from the following incidence matrix. <table border="1"><tr><td></td><td>E₁</td><td>E₂</td><td>E₃</td><td>E₄</td><td>E₅</td><td>E₆</td><td>E₇</td><td>E₈</td></tr><tr><td>V₁</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>V₂</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td></tr><tr><td>V₃</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>V₄</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td>V₅</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td></tr></table>		E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₇	E ₈	V ₁	1	1	1	0	0	0	0	0	V ₂	0	1	1	1	0	1	1	0	V ₃	0	0	0	1	1	0	0	0	V ₄	0	0	0	0	0	0	1	1	V ₅	0	0	0	0	1	1	0	0	[3]
	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₇	E ₈																																																
V ₁	1	1	1	0	0	0	0	0																																																
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V ₄	0	0	0	0	0	0	1	1																																																
V ₅	0	0	0	0	1	1	0	0																																																
b)	The adjacency list of an undirected Graph G = (V, E) is provided as follows. <table><thead><tr><th><u>Vertex</u></th><th><u>Adjacent vertices</u></th></tr></thead><tbody><tr><td>0</td><td>2, 4, 5, 6</td></tr><tr><td>1</td><td>5, 4, 2</td></tr><tr><td>2</td><td>1, 0, 3</td></tr><tr><td>3</td><td>2, 4, 5, 6</td></tr><tr><td>4</td><td>3, 0, 1</td></tr><tr><td>5</td><td>1, 0, 3</td></tr><tr><td>6</td><td>0, 3</td></tr></tbody></table> <p>i. Find the degree of each vertex from the graph. ii. Show that the total degree is twice the number of the total edges for this undirected graph.</p>	<u>Vertex</u>	<u>Adjacent vertices</u>	0	2, 4, 5, 6	1	5, 4, 2	2	1, 0, 3	3	2, 4, 5, 6	4	3, 0, 1	5	1, 0, 3	6	0, 3	[2]																																						
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4	3, 0, 1																																																							
5	1, 0, 3																																																							
6	0, 3																																																							

Question 2.

a)	What is the total number of vertices and edges in an undirected connected graph with a total degree of 40, 5 vertices of degree 4, 4 vertices of degree 3 and x vertices of degree 4?	[2]
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b)	Use two coloring method to determine whether the following graph is bipartite or not.	[3]

Question 3:

a)	A tree has 11 vertices, namely a,b,c,d,e,f,g,h,i,j and k. Here are some information about the vertices: i. a is the root ii. The ancestors of k are (in the decreasing order of level) g,f,b and a iii. i and j are children of c iv. d and e are siblings of f v. f is the parent of h vi. c is in level 1 Draw the rooted tree.	[3]
b)	A full m-ary tree has 53 internal vertices and 319 leaves. Find out the value of m.	[2]

Question 4:

a)	Draw a binary search tree using the following words. Consider dictionary order of the words. Job, Five, Suffer, Smooth, Remarkable, Bird, Carry, Design.	[2]
b)	Show the postfix notation for the following expression: $(a + b * c) / 7 + (3 \uparrow 2 * (d - e)) + (f + 8)$	[3]

Question 5:

a)	A company stores its products in a warehouse. Storage bins in this warehouse are specified by their aisle, location in the aisle, and shelf. There are 80 aisles, 120 horizontal locations in each aisle, and 6 shelves throughout the warehouse. At least how many products must there be in the warehouse so that at least two products must be stored in the same bin?	[2]
b)	The Marvelous chocolate company makes 16 different flavors of chocolates, each of three different sizes – large, medium and small. The company makes gift boxes on special occasions which contain eight chocolates – all of different flavors. The boxes also contain chocolates of different sizes – three small chocolates, three medium ones, and two large ones. How many ways can the chocolate boxes made?	[3]



United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam: : Trimester: Spring 2021

Course Code: CSE 2213, Course Title: DISCRETE MATHEMATICS

Time:1 hour 30 min Total Marks: 40

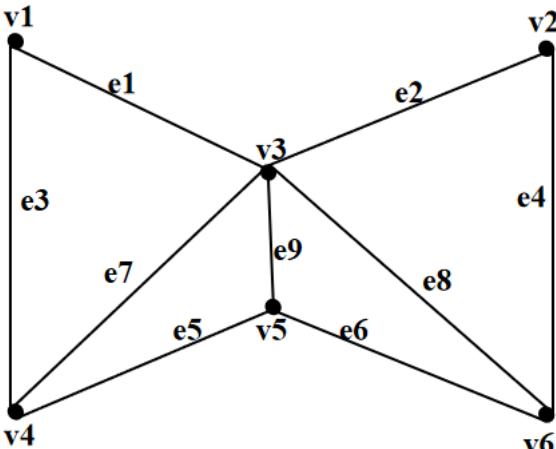
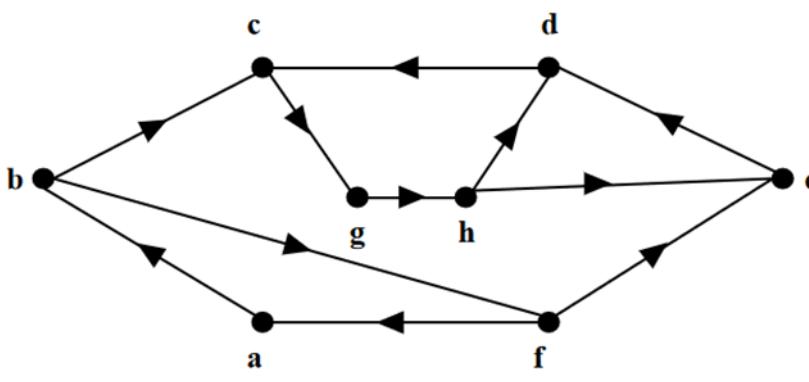
Answer all the questions. Figures are in the right-hand margin indicate full marks.

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Question 1.

a)	A simple undirected graph $G = (V, E)$ has $\sum_{v \in V} \deg(v) = 60$. In this graph, 4 vertices have degree 6, x vertices have degree 3, and 12 vertices have degree 2. What are the total number of vertices and edges of the graph? [2.5]																						
b)	A connected directed multigraph with loops has 6 vertices and 11 edges. Let the vertices be a, b, c, d, e and f respectively. The in-degree and out-degree of the vertices are shown below in a table:	[2.5]																					
<table border="1"><thead><tr><th>Vertex (v)</th><th>$\deg^-(v)$</th><th>$\deg^+(v)$</th></tr></thead><tbody><tr><td>a</td><td>1</td><td>2</td></tr><tr><td>b</td><td>2</td><td>2</td></tr><tr><td>c</td><td>2</td><td>1</td></tr><tr><td>d</td><td>4</td><td>1</td></tr><tr><td>e</td><td>1</td><td>2</td></tr><tr><td>f</td><td>1</td><td>3</td></tr></tbody></table>			Vertex (v)	$\deg^-(v)$	$\deg^+(v)$	a	1	2	b	2	2	c	2	1	d	4	1	e	1	2	f	1	3
Vertex (v)	$\deg^-(v)$	$\deg^+(v)$																					
a	1	2																					
b	2	2																					
c	2	1																					
d	4	1																					
e	1	2																					
f	1	3																					
c)	Is the above description valid? Give explanation for your answer. Use two-coloring method to determine whether the graph is bipartite or not? [5]																						

Question 2.

a)	Show the incidence matrix representation of the following graph.	[2.5]
		
b)	Determine whether the following graph is strongly connected and if not, then find the strongly connected components of the graph.	[2.5]
		
c)	Draw a directed graph represented by the given adjacency matrix and answer the following questions.	[3+2=5]
	$ \begin{array}{ccccccc} & a & b & c & d & e & f \\ a & \left(\begin{array}{cccccc} 0 & 1 & 0 & 0 & 1 & 2 \\ 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 3 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 \end{array} \right) \end{array} $	
	Write down the paths from d to a from the graph having the length of 3 or less.	
Question 3:		
a)	i. Construct a binary search tree from the following sequence of numbers: 50, 30, 90, -10, 120, -40, 70, 60, -20, 80.	[2]
b)	i. Draw an ordered rooted tree (T) from the following expression: $2 + 3/(2 - 1) + 5 * (4 - 1)$ ii. Find the prefix expression from the above rooted tree (T) and find the result from the prefix expression.	[2+2+2=6]
c)	Calculate the number of total edges in a full 3-ary tree with 24 internal vertices.	[2]

Question 4:		
a)	There are 64 districts in Bangladesh. At least how many students must be enrolled to United International University so that we can ensure that there are at least 20 students from the same district?	[2]
b)	Calculate how many ways the letters of the word “ARISTOTLE” can be arranged, if – (i) The T’s are not together. (ii) The vowels are together. (iii) The consonants are together.	[2+1+1=4]
c)	You have to make a string of length 7, using lowercase letters only. Here are some conditions on the strings: (i) The first letter can be any lowercase letter. (ii) A vowel must be followed by a consonant, and vice versa. (For example, if the first letter is a vowel, then the second one must be a consonant, and the third letter must be a vowel, and so on. Similarly evaluate the case of the first letter is a consonant.) (iii) A letter can be used as many times as possible. How many such strings are there?	[4]



United International University

Department of Computer Science and Engineering

CSE 2213/CSI 219: Discrete Mathematics

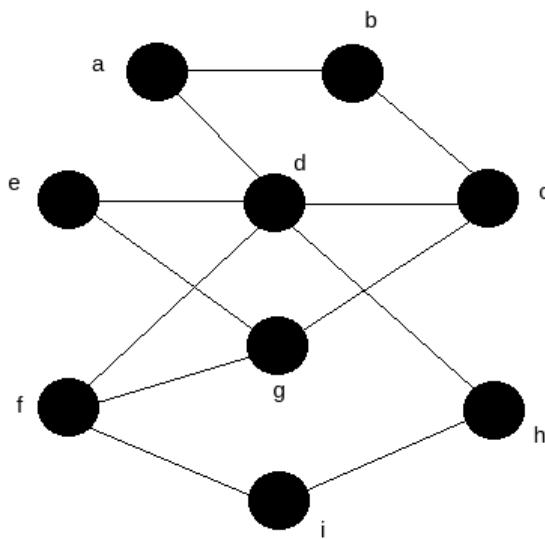
Final Examination : Fall 2021

Total Marks: 40 Time: 2 hours

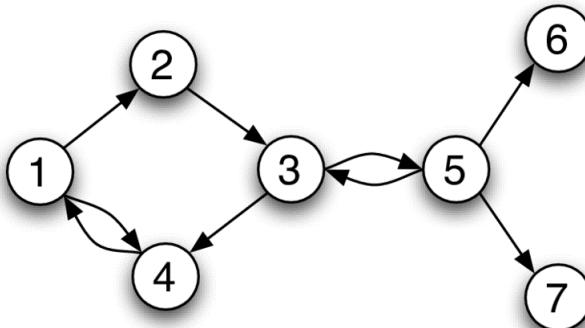
Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

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]



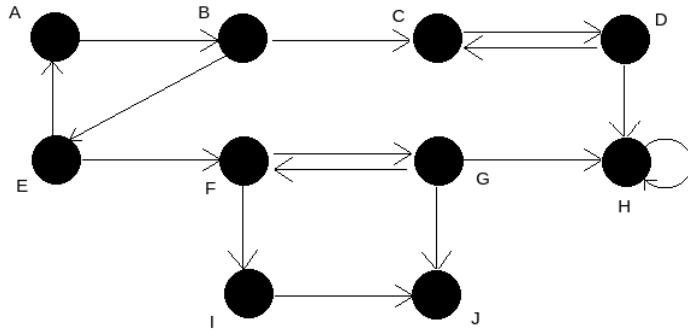
2. (a) Consider the following graph:



- 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):

$$x = (\text{LAST THREE DIGITS OF YOUR STUDENT ID \% 10}) + 70$$

$$y = (\text{LAST THREE DIGITS OF YOUR STUDENT ID \% 10}) + 160$$

- (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 mobile 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]



United International University Department of Computer Science and Engineering

CSE 2213/CSI 219: Discrete Mathematics

Final Examination : Spring 2022

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 6 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]

$$1^2 + 2^2 + 3^2 + 4^2 + \cdots + n^2 = \frac{n(n+1)(2n+1)}{6}$$

2. (a) Suppose a binary search tree has only 4 vertices who have no children. Find out the total number of vertices of the tree. [1]
- (b) Observe these 7 letters from the English alphabet, 'A', 'C', 'E', 'H', 'I', 'S', 'T'. Considering the dictionary order, construct a Binary Search Tree from the letters. [2.5]
- (c) Find out the number of edges and height of the tree you constructed in Question 2(b). Based on the height, what is the maximum limit of the number of leaves in such a tree? [1.5]
- (d) Is the tree you constructed in Question 2(b) a balanced tree? Explain with proper reasoning. [1]
3. (a) Show the order of vertices generated by inorder traversal of the ordered tree in Figure 1. [1]

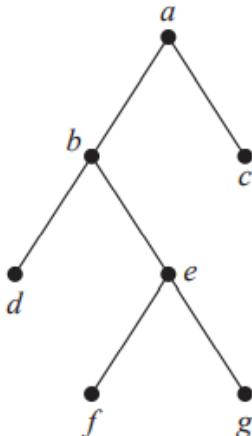


Figure 1: Graph for Question 3(a)

- (b) Show that postorder traversals of both ordered rooted trees in Figure 2 produce the same list of vertices. [2]

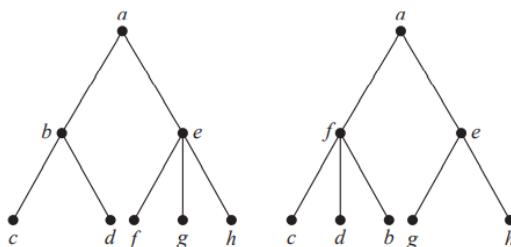


Figure 2: Graph for Question 3(b)

- (c) Represent the expression $((y + 2) \uparrow 3) * (x - (y + 3)) - 8$ using a binary tree. Write this expression in Prefix notation. [2]
- (d) Evaluate the following postfix expression : 9 3 / 5 + 7 2 - * [1]

4. (a) In a road network graph, vertices represent intersections and edges represent roads. If we want to model both one-way and two-way roads, and there is at most one road connecting two intersections, what kind of graph that will be? State your reasoning. [2]
- (b) Suppose, you have been told to draw an undirected graph of 5 vertices with some constraints. The graph must contain at least one vertex of odd-degree, and at least one of even-degree. The odd-degree vertices must have degree 3, and the even-degree vertices must have degree 4. What are the possible number of edges of the graph? [3]
- (c) Find out if the graph in Figure 3 is bipartite or not, using two coloring algorithm. If bipartite, show the graph in bipartite form. [3]

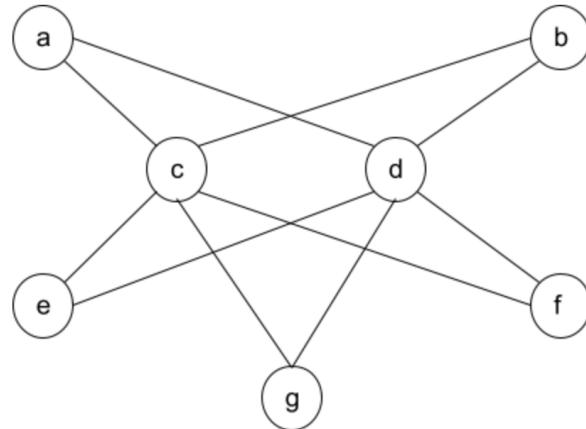


Figure 3: Graph for Question 4(c)

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

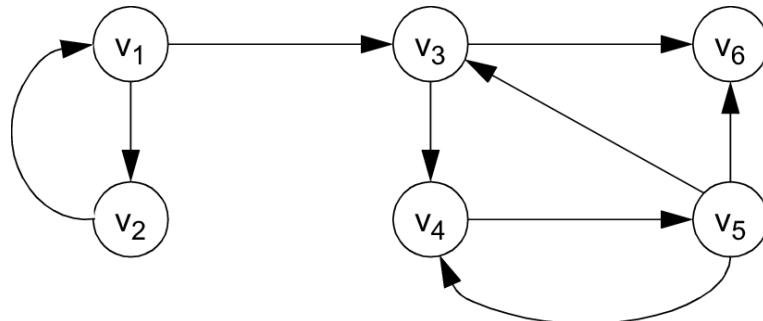


Figure 4: Graph for Question 5(a)

- (b) Find out if Graph 1 and Graph 2 in Figure 5 are isomorphic or not. [2]

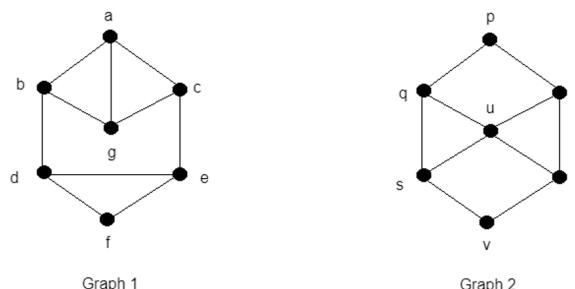


Figure 5: Graph for Question 5(b)

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

[4]

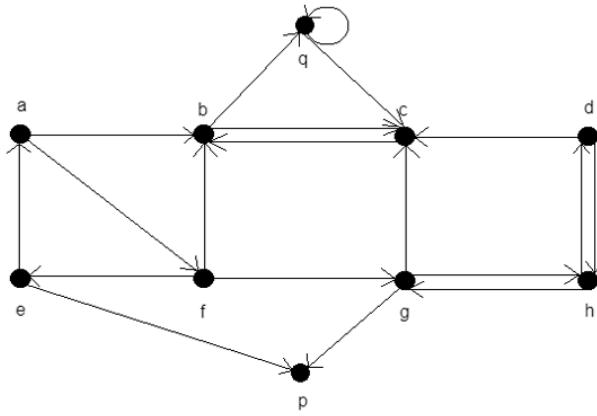


Figure 6: Graph for Question 5(c)

6. (a) If a librarian picks 5 Calculus books from 7 different Calculus books and 4 different Discrete Math books from 6 different Discrete Math books, how many ways he can arrange these 9 books on a shelf such that a Calculus book is at the beginning and a Discrete Math book is in the middle? [Note: each of the Calculus or Discrete Math books is written by different writers] [3]
- (b) From 6 CS faculty and 4 EE faculty, a committee of 6 is to be formed. In how many ways can this be done if the committee contains (i) exactly 2 EE faculty, or (ii) at least 2 EE faculty? [2]
- (c) If a student writes random strings of length 3 using the vowels (A,E,I,O,U) only, how many times he is required to write such strings to be sure that he has written a string twice? [3]

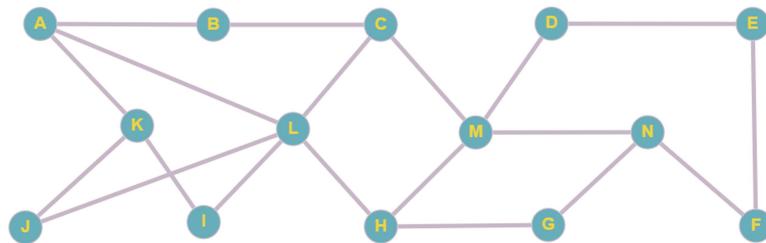


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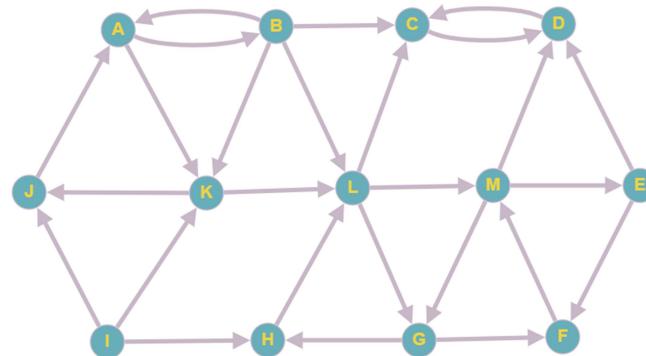
There are **5 (Five)** questions. Answer all 5 (Five) questions. All questions are of values indicated on the right-hand margin.

Q1. a. A complete graph K_n and a wheel graph $W_{(n-1)}$ have the same number of edges n . What is the value of n ? **[2]**

Q1. b. Using two-coloring algorithm, find out whether the following graph is bipartite or not. If bipartite, show the graph in bipartite form. **[4]**



Q1. c. Find out the strongly connected components of the following graph. **[3]**



Q2. a. How many strings (considering only lowercase alphabets) are there of length **five** or less that begin and end with the letter "a"? (Do not consider empty string). **[3]**

Q2. b. Suppose that a software company has 7 front-end developers and 9 back-end developers. A standard team is formed by having at least one front-end developer and at least one back-end developer. How many ways are there to form a standard team of seven members so that it must have more front-end developers than back-end developers? **[3]**

Q2. c. In a game of UNO, there are cards of 4 colors- red, green, blue and yellow. There are 25 cards for each color (there are some special cards, but we will not be considering them now). A player has dealt 7 cards in a round. Now using the pigeonhole or generic pigeonhole principle, do the following: **[1+2]**

- Explain why there is no guarantee that a player will get at least 2 blue cards.
- Minimum how many cards should be picked to ensure that he gets at least 3 cards of the same color?

Q3. Use mathematical induction to prove the following summation formula for all positive integer values of n . **[5]**

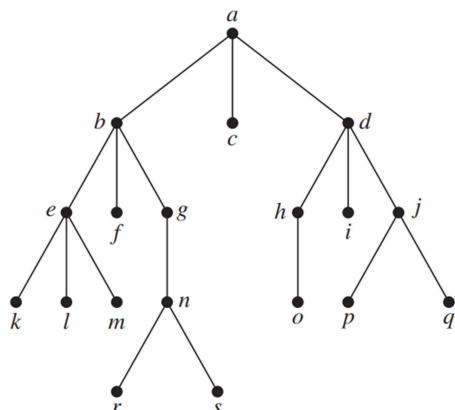
$$\frac{1}{2 \times 5} + \frac{1}{5 \times 8} + \frac{1}{8 \times 11} + \dots + \frac{1}{(3n-1)(3n+2)} = \frac{n}{6n+4}$$

Q4. a. Form a binary search tree for the words: *mathematics, physics, geography, radiology, technology, meteorology, geology, criminology, psychology, neurology, chemistry, terminiate* (use alphabetical order). **[2]**



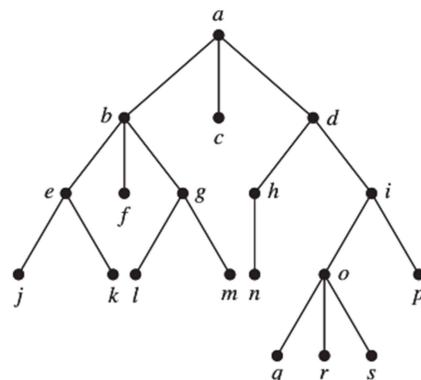
Q4. b. Is the tree you constructed in Q4. (a) A balanced tree? Explain with proper justification. What is the maximum limit of the number of leaves in this tree? [1+1]

Q4. c. Traverse the following tree using post-order technique. You must show all the steps in the process. [2.5]



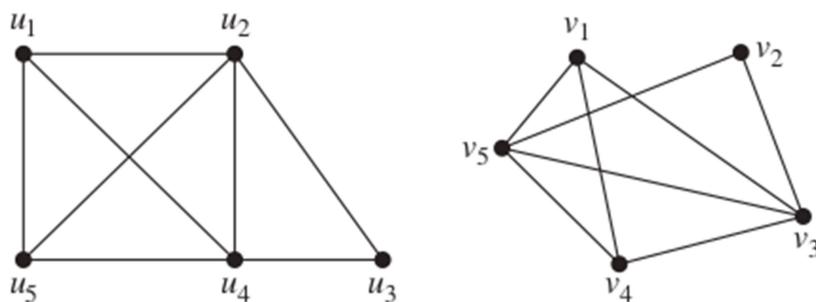
Q4. d. Represent the expression $x + ((x * y + x) / y)$ using binary tree. Write the expression in prefix notation. Evaluate the prefix expression that you created using values of $x = 4$, and $y = 3$. [1+1] [+0.5]

Q5. a. Is the rooted tree in the figure a full m -ary tree for some positive integer m ? If yes, what is the possible value of m ? If not, how can you make it a full m -ary tree? [1+2]



Q5. b. A full m -ary tree has 136 vertices. Among them, 109 are leaves. Calculate the values of m , and the number of edges in the tree. [2]

Q5. c. Find the degree sequences of both the graphs. Determine whether the given pair of graphs is isomorphic. [3]



Good Luck



**Answer all the questions. Figures are 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.**

1. (a) In a road network graph, vertices represent intersections and edges represent roads. If we want to model both one-way and two-way roads, what kind of graph that will be? Why? [1]
- (b) Suppose a graph has 11 vertices and 19 edges. Each of the odd-degree vertices has degree 3 and each of the even-degree vertices has degree 4. Find the numbers of the odd-degree and the even-degree vertices. [2]
- (c) Determine whether the following graph is a bipartite graph. [2]

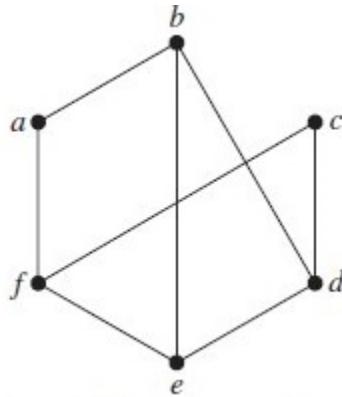


Figure for question 1 (c)

2. (a) Explain why the graph below is not a strongly connected graph. Also, explain why it is weakly connected. Determine the strongly connected components from the graph. [1.5]

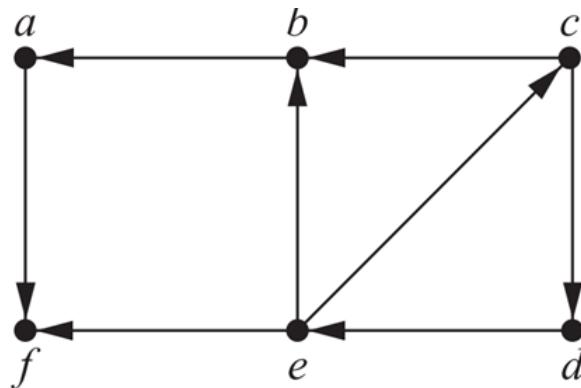


Figure for question 2 (a)

- (b) Draw a directed weakly connected graph of your choice. [1.5]

- (c) The following matrix represents the adjacency matrix of a directed graph consisting of six vertices - a, b, c, d, e and f . [2]

$$A = \begin{pmatrix} & a & b & c & d & e & f \\ a & 0 & 1 & 0 & 0 & 0 & 1 \\ b & 1 & 0 & 1 & 0 & 1 & 0 \\ c & 0 & 0 & 1 & 1 & 1 & 0 \\ d & 0 & 0 & 0 & 0 & 1 & 0 \\ e & 0 & 0 & 1 & 0 & 0 & 0 \\ f & 1 & 0 & 0 & 0 & 1 & 0 \end{pmatrix}$$

Draw the graph from the adjacency matrix.

3. (a) Draw a tree using the following information: [0.25 × 12 = 3]
- i The parent of h is g.
 - ii The ancestors of d are (from top to bottom) g, f and l.
 - iii e, k and l are siblings.
 - iv The descendants of h are a, b, i and j.
 - v a, b, c and d are leaves at level 3.
 - vi a and b has no other siblings.
 - vii e, j and k are leaves.
 - viii The tree is balanced.
- (b) A full m-ary tree has 136 vertices. Among them, 109 are leaves. Calculate the values of m, and the number of edges in the tree. [2]
4. (a) Considering the dictionary order, construct a Binary Search Tree from the strings given below. You must follow the order in which the strings are given. [2]

Binary, Search, Tree, Is, A, Very, Efficient, Data, Structure, For, Searching

- (b) Show the result of post-order traversal on the tree you constructed. [2]
- (c) Is the tree you constructed a balanced tree? Explain your answer in one sentence. [1]
5. (a) In a game of UNO, there are cards of 4 colors- red, green, blue and yellow. There are 25 cards for each color [1 + 1 = 2] (there are some special cards, but we will not be considering them now). A player is dealt 7 cards in a round.
- i Explain why there is no guarantee that a player will get at least 2 red cards.
 - ii How many cards should be picked to ensure that he gets at least 2 red cards?
- (b) A coin is tossed 6 times such that every time it can land either on heads or tails. How many possible outcomes contain an odd number of heads? [1]
- (c) There are n_1 computer science courses and n_2 computer engineering courses available at a certain university. A student has to select r_1 courses from computer science courses and r_2 courses from computer engineering courses. If the order of the courses taken are important, then how many ways can a student complete the courses? [2]



United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam: : Trimester: Fall 2020

Course Code: CSE 2213, Course Title: DISCRETE MATHEMATICS

Time: 1 hour 15 min Total Marks: 25

Answer all the questions. Figures are 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.”

Question 1.

a)	Draw the undirected graph from the following incidence matrix. <table border="1"><tr><td></td><td>E₁</td><td>E₂</td><td>E₃</td><td>E₄</td><td>E₅</td><td>E₆</td><td>E₇</td><td>E₈</td></tr><tr><td>V₁</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>V₂</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td></tr><tr><td>V₃</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>V₄</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td>V₅</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td></tr></table>		E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₇	E ₈	V ₁	1	1	1	0	0	0	0	0	V ₂	0	1	1	1	0	1	1	0	V ₃	0	0	0	1	1	0	0	0	V ₄	0	0	0	0	0	0	1	1	V ₅	0	0	0	0	1	1	0	0	[3]
	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₇	E ₈																																																
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V ₅	0	0	0	0	1	1	0	0																																																
b)	The adjacency list of an undirected Graph G = (V, E) is provided as follows. <table><thead><tr><th><u>Vertex</u></th><th><u>Adjacent vertices</u></th></tr></thead><tbody><tr><td>0</td><td>2, 4, 5, 6</td></tr><tr><td>1</td><td>5, 4, 2</td></tr><tr><td>2</td><td>1, 0, 3</td></tr><tr><td>3</td><td>2, 4, 5, 6</td></tr><tr><td>4</td><td>3, 0, 1</td></tr><tr><td>5</td><td>1, 0, 3</td></tr><tr><td>6</td><td>0, 3</td></tr></tbody></table> <p>i. Find the degree of each vertex from the graph. ii. Show that the total degree is twice the number of the total edges for this undirected graph.</p>	<u>Vertex</u>	<u>Adjacent vertices</u>	0	2, 4, 5, 6	1	5, 4, 2	2	1, 0, 3	3	2, 4, 5, 6	4	3, 0, 1	5	1, 0, 3	6	0, 3	[2]																																						
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5	1, 0, 3																																																							
6	0, 3																																																							

Question 2.

a)	What is the total number of vertices and edges in an undirected connected graph with a total degree of 40, 5 vertices of degree 4, 4 vertices of degree 3 and x vertices of degree 4?	[2]
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b)	Use two coloring method to determine whether the following graph is bipartite or not.	[3]
<pre> graph LR 1 --- 2 1 --- 3 1 --- 5 2 --- 6 3 --- 4 3 --- 8 4 --- 8 4 --- 6 5 --- 6 5 --- 7 5 --- 8 6 --- 8 7 --- 8 </pre>		

Question 3:

a)	A tree has 11 vertices, namely a,b,c,d,e,f,g,h,i,j and k. Here are some information about the vertices: i. a is the root ii. The ancestors of k are (in the decreasing order of level) g,f,b and a iii. i and j are children of c iv. d and e are siblings of f v. f is the parent of h vi. c is in level 1 Draw the rooted tree.	[3]
b)	A full m-ary tree has 53 internal vertices and 319 leaves. Find out the value of m.	[2]

Question 4:

a)	Draw a binary search tree using the following words. Consider dictionary order of the words. Job, Five, Suffer, Smooth, Remarkable, Bird, Carry, Design.	[2]
b)	Show the postfix notation for the following expression: $(a + b * c) / 7 + (3 \uparrow 2 * (d - e)) + (f + 8)$	[3]

Question 5:

a)	A company stores its products in a warehouse. Storage bins in this warehouse are specified by their aisle, location in the aisle, and shelf. There are 80 aisles, 120 horizontal locations in each aisle, and 6 shelves throughout the warehouse. At least how many products must there be in the warehouse so that at least two products must be stored in the same bin?	[2]
b)	The Marvelous chocolate company makes 16 different flavors of chocolates, each of three different sizes – large, medium and small. The company makes gift boxes on special occasions which contain eight chocolates – all of different flavors. The boxes also contain chocolates of different sizes – three small chocolates, three medium ones, and two large ones. How many ways can the chocolate boxes made?	[3]



United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Final Exam. :: Trimester: Fall 2019

Course Code: CSE 2213, Course Title: DISCRETE MATHEMATICS

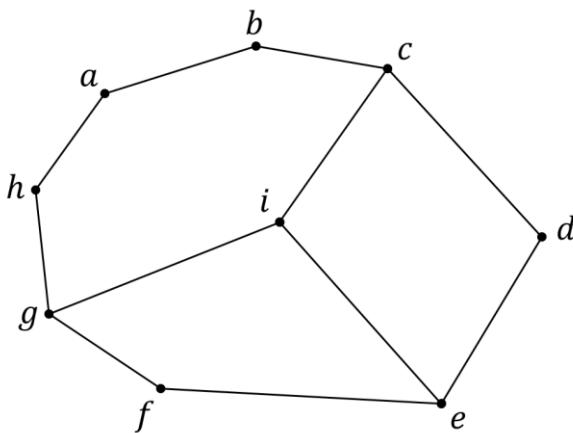
Total Marks: 40

Duration: 2 hr

Answer all the questions. Figures are in the right-hand margin indicate full marks.

Question 1

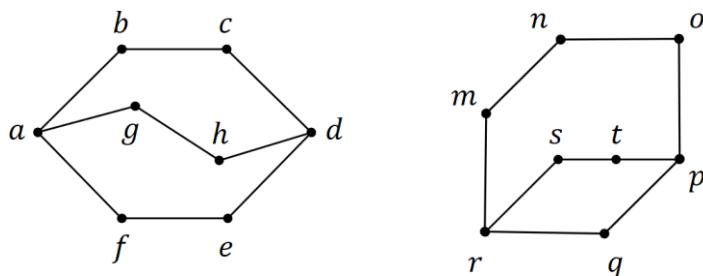
- a) Find out if the following graph is bipartite or not, using two coloring algorithm. If bipartite, show the graph in bipartite form. [4]



- b) Using handshaking theorem, show that a complete bipartite graph $K_{m,n}$ has mn edges. [2]
- c) An undirected graph has 9 vertices. 4 of them are of degree x , and the remaining 5 are of degree y . Which one among x and y must be even? Explain your answer using handshaking theorem. [2]

Question 2

- a) Find out if the following graphs are isomorphic. [3]

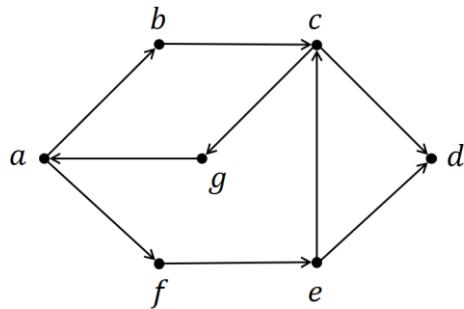


- b) The adjacency list of a graph is given here. Draw the graph. [3]

Vertex	Adjacency
a	b, e
b	a, c, d, f
c	d
d	e, f
e	a, d
f	b

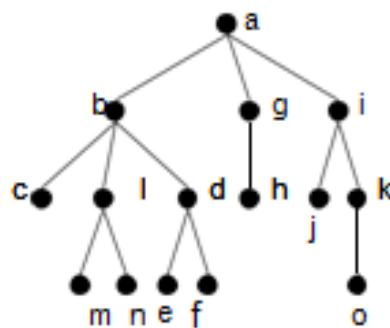
Question 2 (continued)

- c) Find out if the following graph is strongly connected. Explain your answer briefly. [2]



Question 3

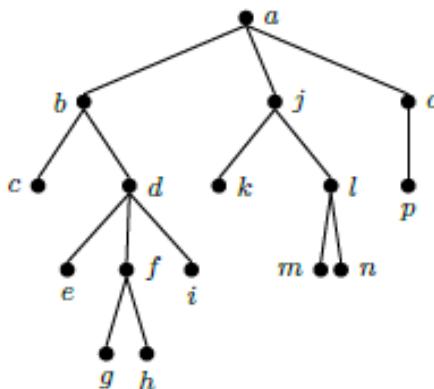
- a) How many leaves does a full 3-ary tree with 100 vertices have? [2]
- b) Find the preorder, inorder and postorder traversal orders of the following tree: [3]



- c) Evaluate the following expressions: [1.5+1.5]
- $+ - \uparrow 3 2 \uparrow 2 3 / 6 - 4 2$
 - $3 2 * 2 \uparrow 5 3 - 8 4 / * -$

Question 4

- a) Construct a binary search tree using the following integers: [3]
10, 5, 15, -5, 4, 25, 20
- b) How do you determine whether a rooted m-ary tree is balanced or not? Find out if the following tree (T) is balanced? [1+1]



T

- c) Find the following from the tree in Question 4(b). [1+1+1]
- Ancestors of h
 - parent of a
 - sub-tree rooted at o

Question 5

- a) The vehicle registration numbers in Dhaka city are formed as follow: first, these registration numbers contain the words “Dhaka Metro”, followed by the vehicle class (represented by one of 31 Bangla letters), vehicle series (a 2-digit number from 11 to 99), and the vehicle number (represented by a 4-digit number). How many registration numbers can be created in this way? [3]
- b) Among a set of 5 black balls and 3 red balls, how many selections of 5 balls can be made such that at least 3 of them are black balls. [3]
- c) How many 4 digit numbers that are divisible by 10 can be formed from the numbers 3, 5, 7, 8, 9, 0 such that no number repeats? [2]