KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Marks Scored:

Level : B.Sc.
Year : III

Course : COMP 323
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date 27 FEB 2025

SECTION "A"
[10Q. × 0.5 = 5 marks]

Fill in the blank space(s) by the most appropriate word(s) or symbol(s).

1. Two graphs are said to be ________________ if there exists a one-to-one correspondence between vertex sets that preserve adjacency.
2. A graph is called a Eulerian graph if it contains a Eulerian ________________ which is a trail that visits every edge exactly once.
3. The maximum number of edges in a simple graph with n vertices is given by $|E| \leq$ ________________.
4. The number of spanning trees of a complete graph with n vertices is given by ________________.
5. In an undirected graph, the integral power of the adjacency matrix A^k gives the number of paths of length ________________ between any two vertices.
6. The diameter of a tree is the length of the ________________ path between any two vertices.
7. The number of fundamental circuits in a connected graph with n vertices and m edges is given by ________________.
8. A bridge in a connected graph is an edge whose removal increases the number of ________________.
9. The Three Utilities Problem proves that ________________ is non-planar.
10. Hall's matching condition is necessary and sufficient condition for a bipartite graph to have a perfect matching. The condition is that for every subset S of the vertices in one set of the partition, the number of neighbors should be at least ________________.

SECTION "B"

[10 Q. × 0.5 = 5 marks]

Fill in the blank space(s), **DO NOT TICK**, by selecting the most appropriate answers from among the given ones.

11. If a graph has exactly two vertices of odd degree, then it has ______________________.
[an Eulerian path; a Hamiltonian path; an Eulerian circuit; a Hamiltonian cycle]

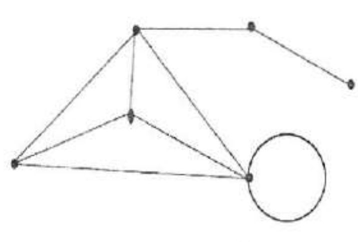
12. A Hamiltonian graph must have ______________________.
[at least one vertex of degree one; a cycle that visits every edge exactly once; a cycle that visits every node exactly once; no cycles at all]

13. A graph G with n vertices contains a Hamiltonian cycle if it satisfies:
____
[$\sum_{v \in V} \deg(v) = 2|E|$; $\deg(v) \geq \frac{n}{2}\ \forall v \in V$; $v\ is\ odd\ \forall v \in V$; $|E| = \frac{n(n-1)}{2}$]

14. The maximum number of edges in a planar simple graph with n vertices is ______________________.
[$3n - 6$; $n^2 - n$; $2n - 5$; $4n - 8$]

15. The Petersen graph is ______________________.
[planar; non-planar; bipartite; Eulerian]

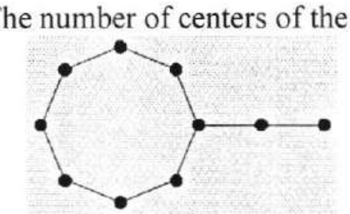
16. The number of regions in the graph below is ______________________.



[4; 5; 6; 7]

17. What will be the chromatic number for an isolated graph with n vertices?
____
[0 1; 2; n]

18. The number of centers of the graph below is ______________________.



[1; 2; 3; 4]

19. The critical path in an activity network is ________________________________.

[a mixture of all the paths;
the longest path
the shortest path;
a path that operates from the starting node to the end node]

20. In any graph G, the relation between chromatic number $\chi(G)$ and clique number $\omega(G)$ is given by______________________.

[$\chi(G) \geq \omega(G)$; $\omega(G) \geq \chi(G)$; $\chi(G) \geq \omega(G) + 1$; $\omega(G) \geq \chi(G) + 1$]

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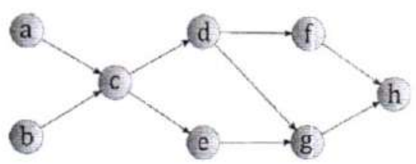
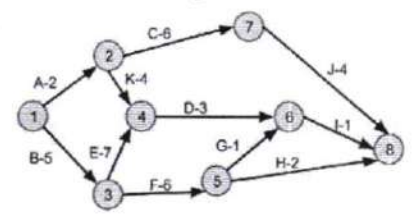
SECTION "C"
[2Q. × 6 = 12 marks]

1. Define activity network. [1+2.5+2.5]
   a. Find the topological ordering of the directed graph given below.



   b. Find the critical path from the activity network below.



2. Explain the concept of matching in a graph. Differentiate between maximal matching, maximum matching, and perfect matching with suitable examples. Also, state Hall's Matching Theorem for a bipartite graph. [1+2+3]

OR

State Marriage Theorem. Discuss Gale-Shapley algorithm for stable marriage. Find the stable matching for men with the following preferences: [1+2+3]

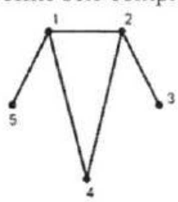
Men	Preference List (Most Preferred → Least Preferred)
M_1	$W_3, W_1, W_2, W_6, W_4, W_5$
M_2	$W_2, W_4, W_1, W_6, W_3, W_5$
M_3	$W_1, W_2, W_3, W_4, W_6, W_5$
M_4	$W_4, W_5, W_2, W_1, W_6, W_3$
M_5	$W_6, W_3, W_2, W_4, W_1, W_5$
M_6	$W_2, W_4, W_6, W_1, W_3, W_5$

Women	Preference List (Most Preferred → Least Preferred)
W_1	$M_1, M_3, M_2, M_6, M_4, M_5$
W_2	$M_2, M_1, M_6, M_3, M_4, M_5$
W_3	$M_5, M_3, M_1, M_2, M_4, M_6$
W_4	$M_4, M_2, M_6, M_1, M_3, M_5$
W_5	$M_6, M_4, M_2, M_5, M_1, M_3$
W_6	$M_5, M_1, M_2, M_6, M_4, M_3$

SECTION "D"

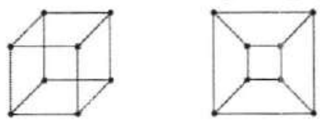
[5Q. × 4 = 20 marks]

3. Define self-complementary graph. Prove that the graph given below is self-complementary. [1+3]



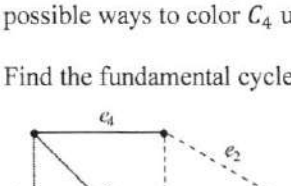
OR

Show that the following two graphs are isomorphic. [4]



4. Find the chromatic polynomial of cycle graph C_4 for given k colors. Also, find the number possible ways to color C_4 using 5 colors. [3+1]

5. Find the fundamental cycle matrix and fundamental cut-set matrix of the given graph below.



6. Deduce the maximum and minimum height of a binary tree with n vertices. [2+2]

7. Given the following Primitive Connection Matrix P:

$$P = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

Find the Transmission Matrix T by calculating $T = P + P^2 + P^3 + \cdots$, where the sum is taken until no new connections appear. [4]

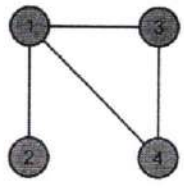
SECTION "E"

[4 Q. × 2 = 8 marks]

8. Find the dual of the complete graph K_4.

27 FEB 2025

9. Find the number of spanning tree of the graph



10. Verify that a simple connected graph is Eulerian if every vertex of the graph is even.

11. Prove that the number of edges of a complete graph K_n is $\frac{n(n-1)}{2}$.