KATHMANDU UNIVERSITY
End Semester Examination [C]
December, 2024

Marks Scored:

Level : B.Sc.
Year : III
Course : COMP 323
Semester : II

Exam Roll No. :
Time: 30 mins.
F. M. : 10

Registration No.:
24 DEC 2024
Date :

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Write the most appropriate answer in the space given in the 'Correct Answer' row in the ANSWER BOX given below.

ANSWER BOX

Question No.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Correct Answer										

Question No.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
Correct Answer										

1. The number of edges in a complete graph K_8 is _____.
   A. 21 B. 28 C. 42 D. 56

2. A node in the graph with degree one is called _____.
   A. isolated vertex B. pendant vertex C. adjacent vertex D. even vertex

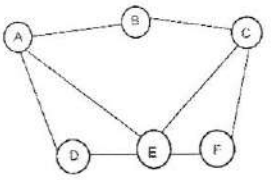
3. Which of the following could be the number of odd vertices in a graph?
   A. 13 B. 15 C. 17 D. 20

4. Arthur-Cayley formula states that the number of spanning trees in a complete graph K_n is _____.
   A. $C(n, 2)$ B. $\frac{n^2}{n^n}$ C. $\frac{n^n}{n^2}$ D. n^{n-3}

5. Which of the following is not true about the path in a connected graph?
   _____.
   A. Path has distinct vertices.
   B. Path has distinct edges.
   C. Path has distinct vertices but not edges.
   D. Path has the vertices of degree two except the first and last vertices.

6. What is the polyhedral with 10 faces called? _____
   A. Icosahedron B. Tetrahedron C. Dodecahedron D. Octahedron

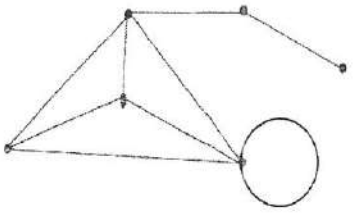
7. The diameter of the graph alongside is _____.



A. 1 B. 2
C. 4 D. 5

8. The least number of nodes in the non-planar graph is _____.
A. 5 B. 6 C. 8 D. 9

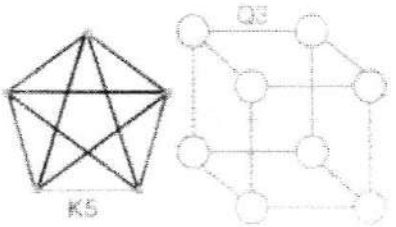
9. The number of vertices in the dual of the graph below is _____.



A. 4 B. 5 C. 6 D. 7

10. Which of the following is incorrect?
A. K_n is planar if and only if $n \leq 4$.
B. $K_{m,n}$ is planar if and only if $m \leq 2$ or $n \leq 2$.
C. $K_{m,n}$ is planar if and only if $m \leq 2$ and $n \leq 2$.
D. A graph is planar if and only if it contains no subgraph homeomorphic to K_5 or $K_{3,3}$.

11. Which of the following is true about these graphs below? _____



A. K_5 is planar but Q_3 is not.
B. Q_3 is planar but K_5 is not.
C. Both K_5 and Q_3 are planar.
D. Neither K_5 not Q_3 is planar.

12. What will be the chromatic number for an empty graph having n vertices?
_____
A.0 B. 1 C. 2 D. n

13. A graph with chromatic number less than or equal to k is called
_____
A. k chromatic B. k colorable
C. k chromatic colorable D. k colorable chromatic

14. Let G be a graph with 10 edges. The number of edges of its dual graph is_____
A. 2 B. 8 C. 6 D. 10

15. In any graph G, the relation between chromatic number $\chi(G)$ and clique number $\omega(G)$ is given by_____.
A. $\chi(G) \geq \omega(G)$ B. $\omega(G) \geq \chi(G)$ C. $\chi(G) \geq \omega(G) + 1$ D. $\omega(G) \geq \chi(G) + 1$

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16. Let $S_1 = \{2,8\}, S_2 = \{8\}, S_3 = \{5,7\}, S_4 = \{2,4\ 8\}$, then SDR for $X = \{S_1, S_2, S_3, S_4\}$ is equal to _____.
A. $\{2,4,5,7\}$ B. $\{2,4,5,8\}$ C. $\{2,4,7,8\}$ D. $\{4,5,7,8\}$

17. Which one of the postulate of the Boolean algebra is not true?
A. $x \cdot (x + y) = x$ B. $x + (x \cdot y) = x$ C. $x + x = x$ D. $x \cdot x' = x$

18. A tournament in graph theory is a directed graph in which_____
A. All vertices are connected to each other
B. There are no cycles
C. There is a directed edge between every pair of distinct vertices
D. There is a cycle between every pair of distinct vertices

19. A cut set in a graph is_____
A. A set of vertices that form a cycle
B. A set of edges that form a complete subgraph
C. A set of vertices whose removal disconnects the graph
D. A set of disconnected vertices

20. The depth of a node in a tree refers to_____
A. The number of edges to the root
B. The number of edges to the furthest leaf
C. The level of the node in the tree
D. The number of children a node has

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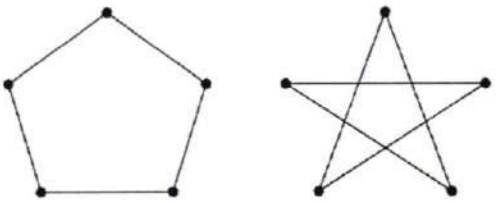
SECTION "B"
[6 Q. × 4 = 24 marks]

Attempt *ANY SIX* questions.

1. Define isomorphic graphs. Determine whether the graphs below are isomorphic or not.



2. Find the maximum and minimum height of a binary tree with n vertices.

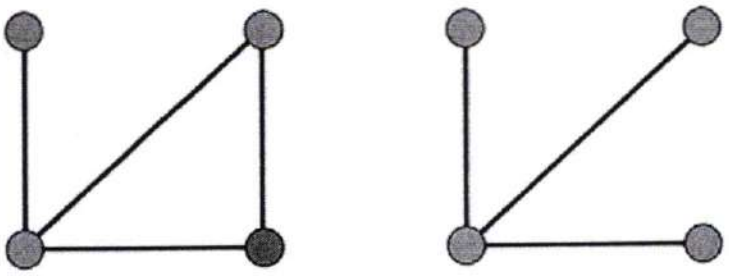
3. What do you mean by graphical sequence? Determine whether the sequence 7,6,6,4,4,4,2,1 is graphical or not.

4. Define dual graph. Show that the four-vertex complete graph is self-dual.

5. Find the chromatic polynomial for the cycle graph c_4.

6. Show that the Petersen graph has a perfect matching.

7. Define complement of a graph. Verify that the complement of the disconnected graph below is connected.



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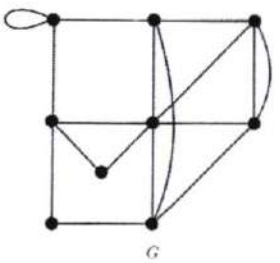
SECTION "C"

[2 Q. × 8 = 16 marks]

Attempt *ANY TWO* questions.

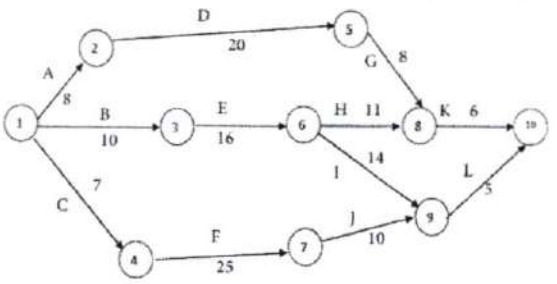
8. Answer the following question based on the graph below. [1+2+2+1+2]



G

a. Construct the corresponding *simple graph* by removing self-loops and multiple edges (if any).
b. Find the *adjacency matrix* of the simple graph.
c. Determine whether the graph is *Eulerian or not*. Justify your answer by examining the necessary conditions for an Eulerian graph.
d. If the graph is Eulerian, find an *Eulerian circuit*.
e. Determine whether the graph is *Hamiltonian*.

9. Given the activity network diagram: [3+3+2]



a. Identify the *critical path* in the network.
b. Determine the *total duration* of the project.
c. Calculate the *maximum permissible delay* (slack) for each non-critical activity.

10. A **System of Distinct Representation (SDR)** for a collection of finite sets $A_1, A_2, \ldots, A_n$ is a set of elements $\{x_1, x_2, \ldots, x_n\}$ where $x_i \in A_i$ for each i, and all the x_i's are distinct. Let the sets be defined as: $A_1 = \{1,2,3,4,5,6\}$, $A_3 = \{1,4,7\}$, $A_4 = \{2,3,5,6\}$, $A_5 = \{3,4,7\}$, $A_6 = \{1,3,4,7\}$, $A_7 = \{1,3,7\}$. [2+2+2+2]

a. Does there exist a system of distinct representation (SDR) for the sets $A_1, A_2, \ldots, A_7$? Justify your answer using Hall's Marriage Theorem.
b. If an SDR exists, provide an example of such an SDR, specifying which element represents each set.
c. Are there multiple possible SDRs for the given sets? If so, provide another distinct SDR or explain why no alternative exists.
d. Suppose A_2 is modified to $A_2 = \{1,4,6\}$. Does an SDR still exist for the modified collection? Explain how this change impacts the existence of an SDR.