ITM(SLS) BARODA UNIVERSITY, VADODARA

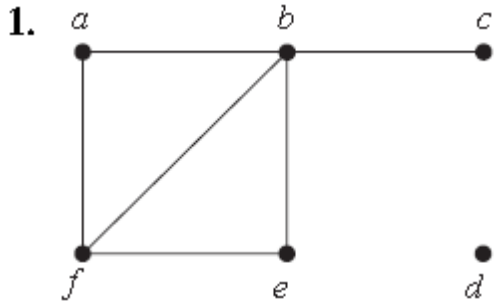
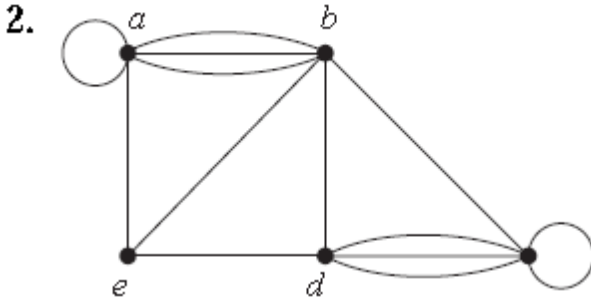
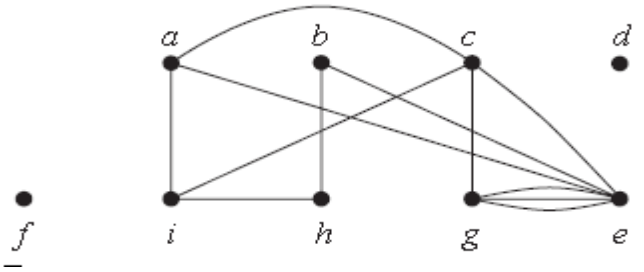
School of Computer Science Engineering & Technology

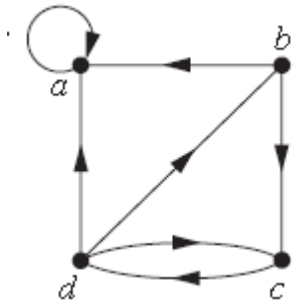
(BTECH.SEM-1)

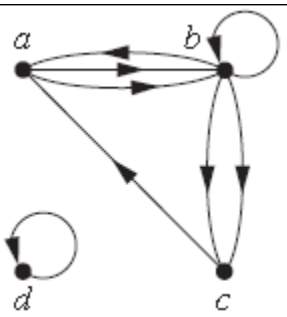
SUBJECT: DISCRETE MATHEMATICS WITH PYTHON

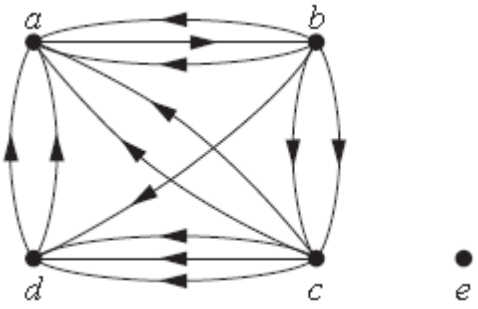
Tutorial-4

Graphs, Types of graphs, subgraphs, connectedness

Q1.	**Define following:** a. Graphs and its type. b. Adjacent nodes and adjacent edge c. Degree of nodes and types of nodes d. Degree of nodes in a directed and undirected graph. e. Types of simple graphs with examples. f. Path, Trail, Cycle, Simple cycle. g. Connectedness in the undirect and directed graph. h. Isomorphism in graphs. i. Bipartite and complete bipartite graph.
Q2.	Find the number of vertices, the number of edges, and the degree of each vertex in the given undirected graph. Identify all isolated and pendant vertices. Verify the Hand-shaking theorem for each graph.
	1.  **2.** 
	3. 
Q3.	Determine the number of vertices and edges and find the in-degree and out-degree of each vertex for the given directed multigraph.





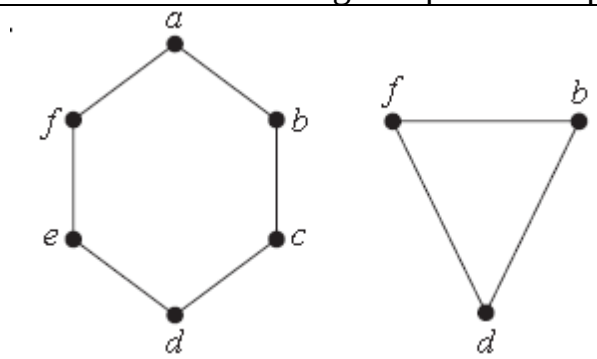


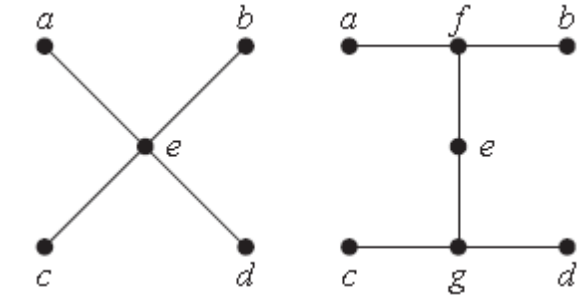
Q4. Draw these graphs.

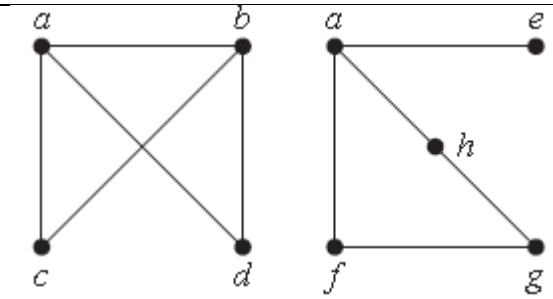
a) $K7$ **b)** $K1,8$ **c)** $K4,4$

d) $C7$ **e)** $W7$ **f)** $Q4$

Q5. Find the union of the given pair of simple graphs.

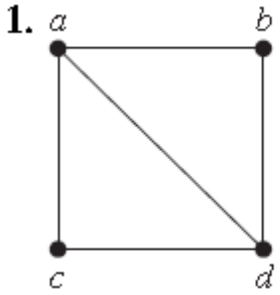






Q6. Use an adjacency matrix to represent the given graph.

1.



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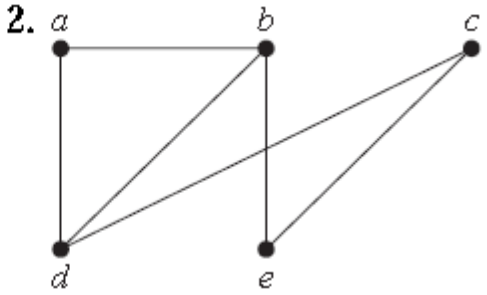

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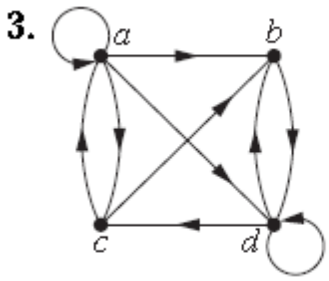

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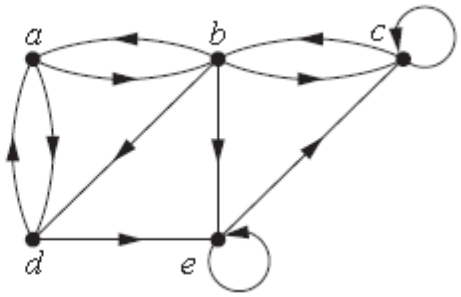


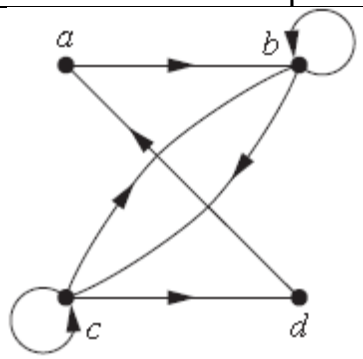
Q7. Draw an undirected graph represented by the given adjacency matrix.

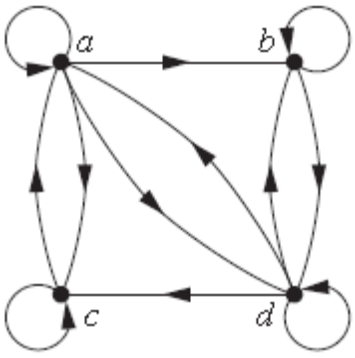
$$\begin{bmatrix} 1 & 3 & 2 \\ 3 & 0 & 4 \\ 2 & 4 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 2 & 0 & 1 \\ 2 & 0 & 3 & 0 \\ 0 & 3 & 1 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$$

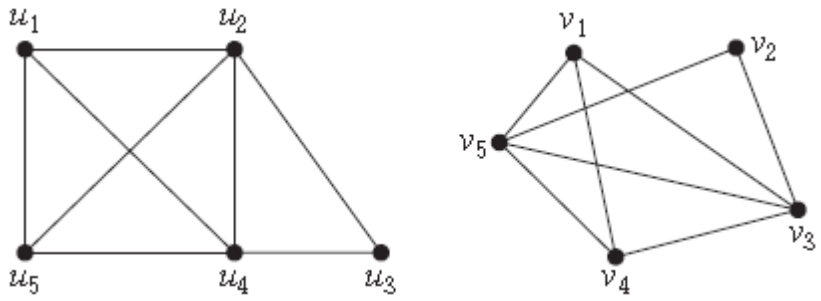
$$\begin{bmatrix} 0 & 1 & 3 & 0 & 4 \\ 1 & 2 & 1 & 3 & 0 \\ 3 & 1 & 1 & 0 & 1 \\ 0 & 3 & 0 & 0 & 2 \\ 4 & 0 & 1 & 2 & 3 \end{bmatrix}$$

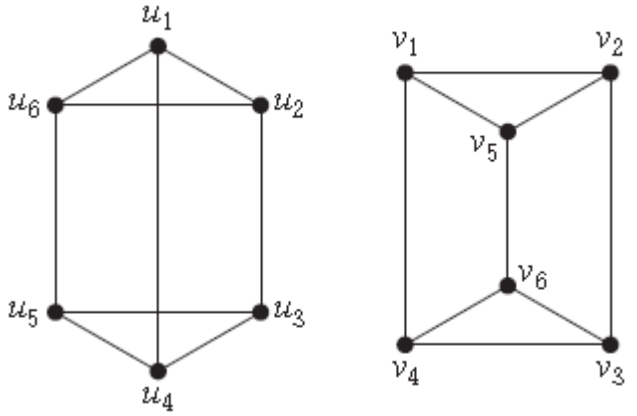
Q8. Find the adjacency matrix of the given directed multigraph with respect to the vertices listed in alphabetic order.





Q9. Determine whether the given pair of graphs is isomorphic.





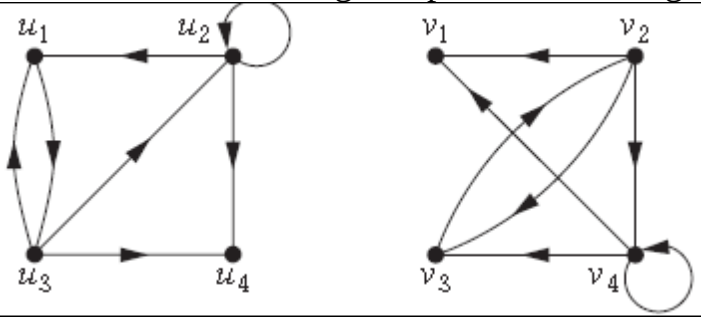
Q10. Are the simple graphs with the following adjacency matrices isomorphic?

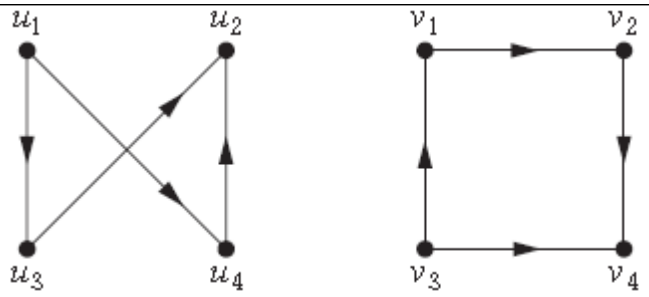
a) $\begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$, $\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 0 \\ 1 & 0 & 0 \end{bmatrix}$

b) $\begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix}$, $\begin{bmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix}$

c) $\begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 0 \end{bmatrix}$, $\begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 \end{bmatrix}$

Q11. Determine whether the given pair of directed graphs are isomorphic.

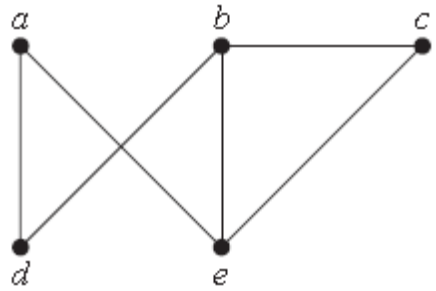




Q 12 Does each of these lists of vertices form a path in the following graph? Which paths are simple? Which are circuits? What are the lengths of those that are paths?

a) *a, e, b, c, b* **b)** *a, e, a, d, b, c, a*

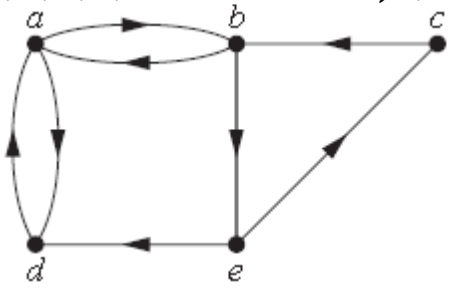
c) *e, b, a, d, b, e* **d)** *c, b, d, a, e, c*



Q 13 Does each of these lists of vertices form a path in the following graph? Which paths are s lengths of those that are paths?

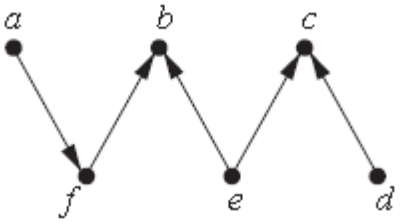
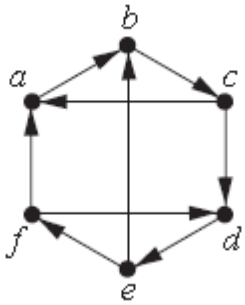
a) *a, b, e, c, b* **b)** *a, d, a, d, a*

c) *a, d, b, e, a* **d)** *a, b, e, c, b, d, a*



Q 14 Determine whether each of these graphs is strongly connected and if not, whether it is weakly connected.

a)



b)