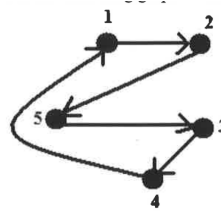


**1. Please answer questions 1 - 3 using the following graph**



**1. Give the binary relation for the graph.**

$\{(1,2), (2,5), (5,3), (3,4), (4,1)\}$

**2. Determine how many paths of length 2 there are using the technique described in the book. Show all work**

$$A = \begin{pmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{pmatrix}$$

$$A^{(2)} = \begin{pmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{pmatrix} \times \begin{pmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{pmatrix}$$

There are 5 paths of length 2:

(1->2->5)

(2->5->3)

(3->4->1)

(4->1->2)

(5->3->4)

**3. Using Warshall's algorithm to determine the reachability matrix. Show all work.**

$$M_0 = \begin{pmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{pmatrix}$$

$$M_1 = \begin{pmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{pmatrix}$$

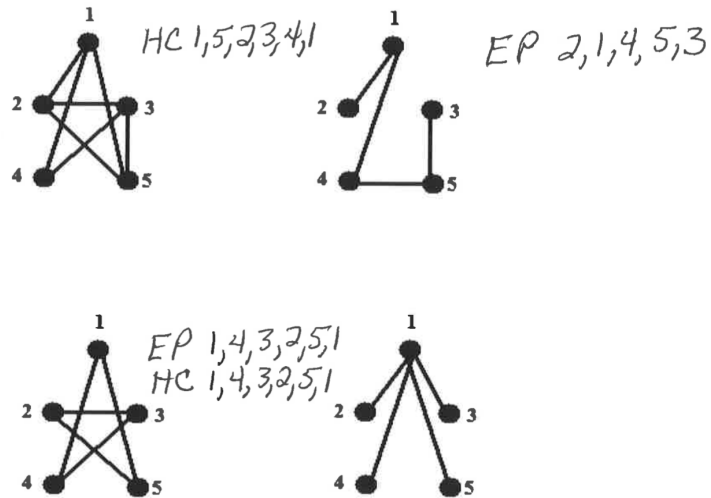
$$M_2 = \begin{pmatrix} 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 \end{pmatrix}$$

$$M_3 = \begin{pmatrix} 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 1 & 0 \end{pmatrix}$$

$$M_4 = \begin{pmatrix} 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

$$R = M_5 = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

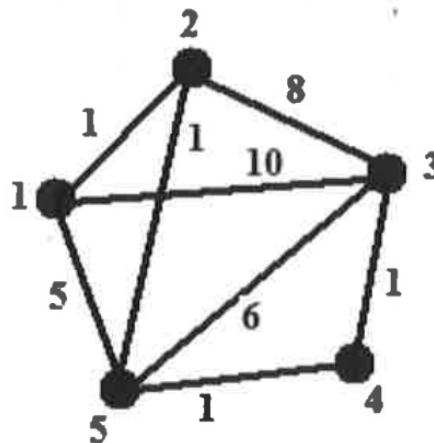
**2. Please answer questions 4 - 5 using the following graphs.**



4. Write EP beside each graph with an Euler Path, then pick one and write the path beside the graph (label it, please).
5. Write HC beside each graph with a Hamiltonian Circuit, then pick one and write the circuit beside the graph (label it, please).

The answer is in the graph.

**3. Use the Dijkstra's algorithm to find the shortest path from 1 to 3 and the length of that path in the following graph. Show all work.**



$A:$ 

	1	2	3	4	5
1	$\infty$	1	10	$\infty$	5
2	1	$\infty$	8	$\infty$	1
3	10	8	$\infty$	1	6
4	$\infty$	$\infty$	1	$\infty$	1
5	5	1	6	1	$\infty$

①  $I_1 = \{1\}$

	1	2	3	4	5
d	0	1	10	$\infty$	5
s	-	1	1	1	1

②  $P = 2, I_1 = \{1, 2\}$

$$d[3] = \min(10, A[1,2] + A[2,3]) = \min(10, 1+8) = 9 \text{ (update)}$$

$$d[4] = \min(\infty, A[1,2] + A[2,4]) = \min(\infty, 1+\infty) = \infty$$

$$d[5] = \min(5, A[1,2] + A[2,5]) = \min(5, 1+1) = 2 \text{ (update)}$$

	1	2	3	4	5
d	0	1	9	$\infty$	2
s	-	1	2	1	2

③  $P = 5, I_1 = \{1, 2, 5\}$

$$d[3] = \min(9, A[1,2] + A[2,5] + A[5,3]) = \min(9, 1+1+6) = 8 \text{ (update)}$$

$$d[4] = \min(\infty, A[1,2] + A[2,5] + A[5,4]) = \min(\infty, 1+1+1) = 3 \text{ (update)}$$

	1	2	3	4	5
d	0	1	8	3	2
s	-	1	5	5	2

④  $P = 4, I_1 = \{1, 2, 5, 4\}$

$$d[3] = \min(8, A[1,2] + A[2,5] + A[5,4] + A[4,3]) = \min(8, 1+1+1+1) = 4 \text{ (update)}$$

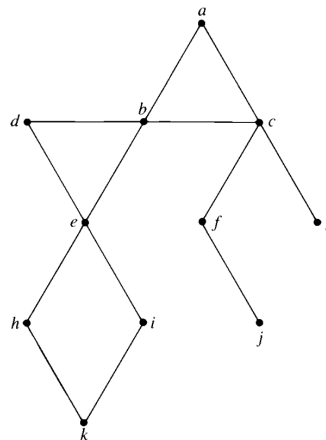
	1	2	3	4	5
d	0	1	4	3	2
s	-	1	4	5	2

⑤  $P = 3, I_1 = \{1, 2, 5, 4, 3\}$ . Finish.

Shortest path from 1 to 3: 4 (length)

① → ② → ⑤ → ④ → ③

#### 4. Using the following graph to answer questions 6 and 7.



6. Do a Depth First Search on the graph beginning at node a.

**a b c f j g d e h k i**

7. Do a Breadth First Search on the graph beginning at node a.

**a b c d e f g h i j k**

In [ ]:

