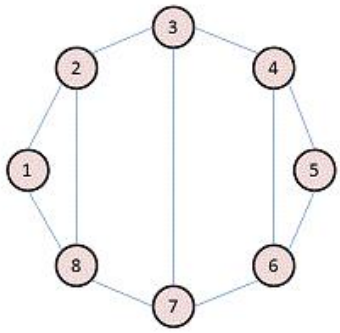
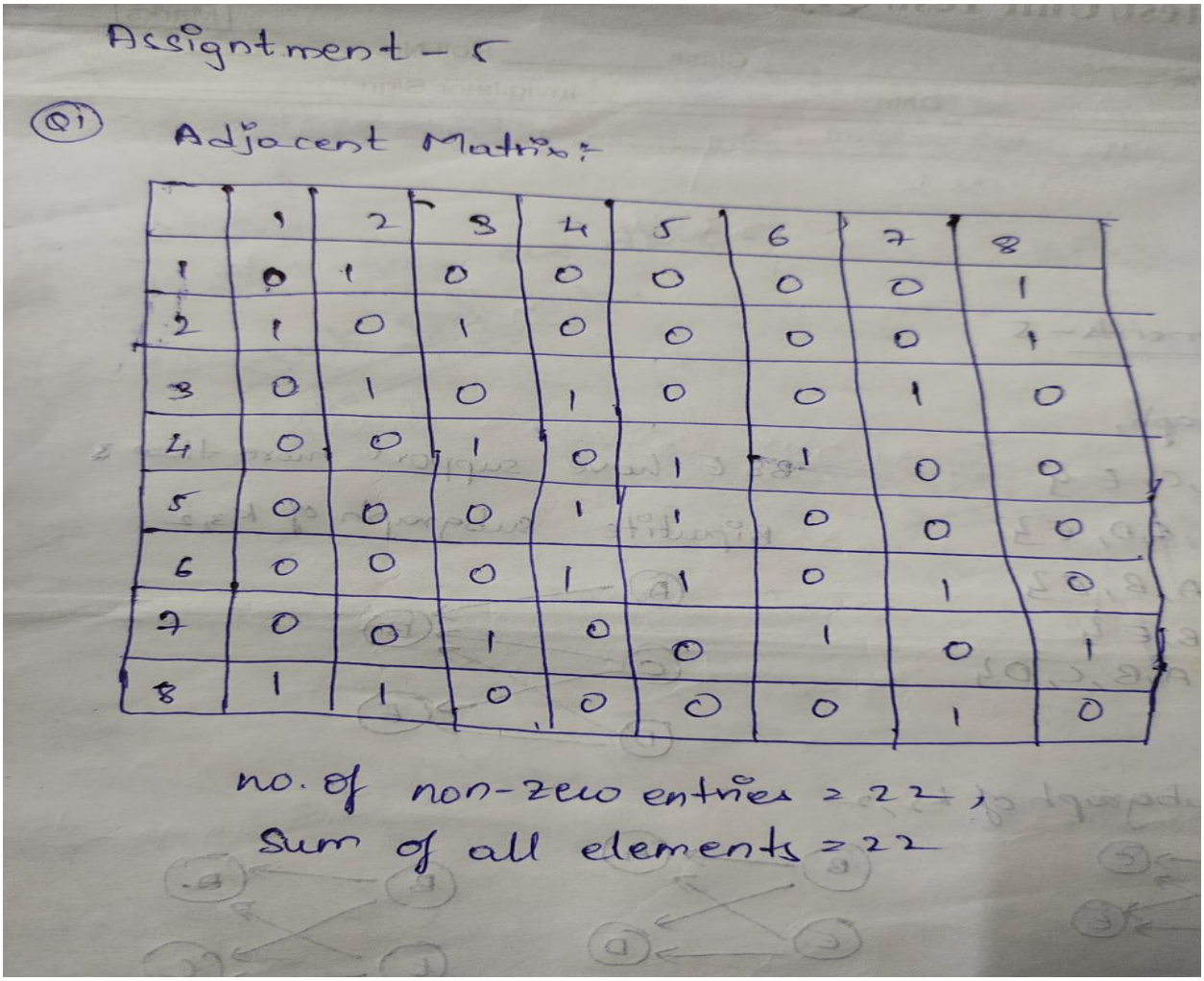
# Communities

**Question 1**:

For the following graph:




Write the adjacency matrix A, the degree matrix D, and the Laplacian matrix L. For each, find the sum of all entries and the number of nonzero entries.



Degree Matrix :

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |

No of non-zero entries = 8

Sum of all entries = 8

Laplacian Matrix ($L = D - A$)

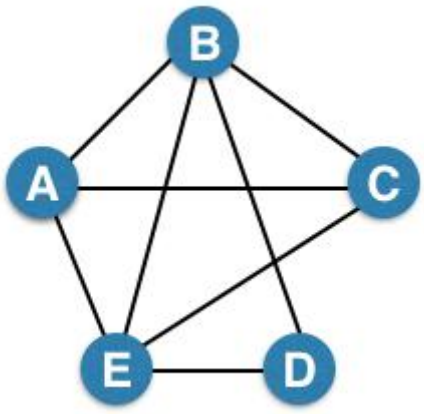
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | -1 | 0 | 0 | 0 | 0 | 0 | -1 |
| 2 | -1 | 3 | -1 | 0 | 0 | 0 | 0 | -1 |
| 3 | 0 | -1 | 3 | -1 | 0 | 0 | -1 | 0 |
| 4 | 0 | 0 | -1 | 3 | -1 | -1 | 0 | 0 |
| 5 | 0 | 0 | 0 | -1 | 2 | -1 | 0 | 0 |
| 6 | 0 | 0 | 0 | -1 | -1 | 3 | -1 | 0 |
| 7 | 0 | 0 | -1 | 0 | 0 | -1 | 3 | -1 |
| 8 | -1 | -1 | 0 | 0 | 0 | 0 | -1 | 3 |

No of non-zero entries = 30

Sum of all entries = 0

**Question 2**:

Consider the following undirected graph (i.e., edges may be considered bidirectional):



Run the "trawling" algorithm for finding dense communities on this graph and find all complete bipartite subgraphs of types $K_{3,2}$ and $K_{2,2}$. Note: In the case of $K_{2,2}$, we consider {{W, X}, {Y, Z}} and {{Y, Z}, {W, X}} to be identical.

Sub _____ Date _____ Invigilator Sign. _____

Assignment-5

(2Q) From graph,

A = {B, C, E}

B = {A, C, D, E}

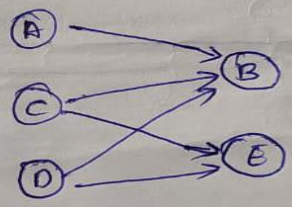
C = {A, B, E}

D = {B, E}

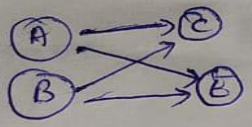
E = {A, B, C, D}

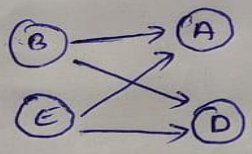
B & E have support more than 3

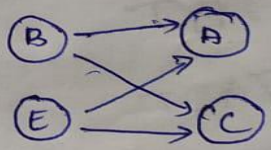
Bipartite subgraph of $K_{3,2}$

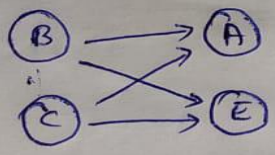


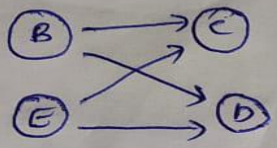

Bipartite subgraph of $K_{2,2}$



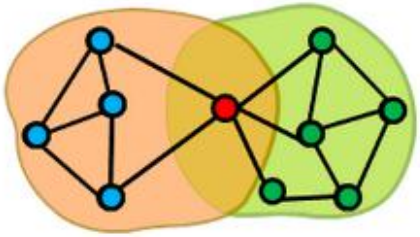



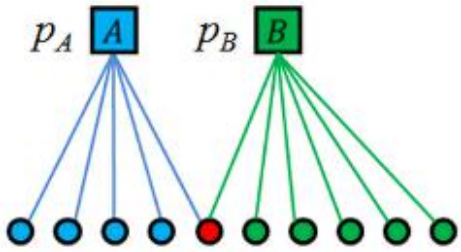



**Question 3**:

We fit AGM to the network on the left, and found the parameters on the right:



Network




Learned AGM parameters

Find the optimal values for $p_A$ and $p_B$.

$P_a$ = (No. of edges in the network)/(Total possible no. of edges) = 7/10 = 0.7

$P_b$ = (No. of edges in the network)/(Total possible no. of edges) = 9/15 = 0.6