LNMIIT

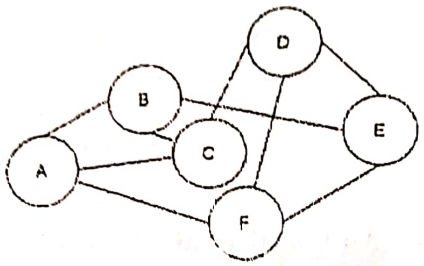
# The LNM Institute of Information Technology
## Department of Computer Science & Engineering
## CSE 3132 Social Network Analysis
### Exam Type: Mid Term

Time: 90 min | 24/02/2020 | Max. Marks: 35

Answer all questions **in the same order as it appears in the question paper.** If there are any assumptions to be made for your answer write clearly the assumption that you are making before answering. Only if the assumption is reasonable it will be considered. **No doubt clarifications in the examination hall!** All the best!

1. What is the diameter of a wheel graph $W_n$ where $|n| \geq 4$ ? Explain briefly how? (2)

2. Consider the undirected graph $G$ given below:




Answer the following with very brief explanation:

(a) Give an example of a walk of length 5 that is not a trail. Why your example is a walk? (1)

(b) Give an example of a trail of length 5 that is not a path. Why your example is a trail? (1)

(c) Give an example of a path that is not closed. Why your example is a path? (1)

3. Pick the correct answer(s) and justify why each of the choice(s) are / is correct or incorrect. Assume that the network that we are considering is huge (You need to explain for all choices why they are true or false to get full marks): (4)

(a) The degree distribution in a Random Network is Poisson and for Social Network it is not Poisson

(b) The degree of most of the nodes in a Random Network hovers around the average degree

(c) The degree of most of the nodes in a Social Network hovers around the average degree

(d) The degree distribution in a Random Network is Binomial

4. For a wheel graph $W_n$ of $n$ vertices where $n \geq 4$ answer the following:

(a) Find the local clustering coefficient of all nodes in $W_5$. (1)

(b) Find the global clustering coefficient of $W_5$ (1)

(c) Find the global clustering coefficient of $W_n$. Explain about how did you get this result? (3)

5. Find the betweenness centrality of a vertex in a complete bipartite graph $K_{3,4}$ and generalise the above result for any complete bipartite graph $K_{m,n}$ (5)

6. Calculate the Jaccard structural equivalence of all pair of vertices in a cycle graph (undirected) and a wheel graph (undirected) containing 5 vertices. Which vertices have similarity? Generalize for any cycle graph and a wheel of $n$ vertices. (3+3)

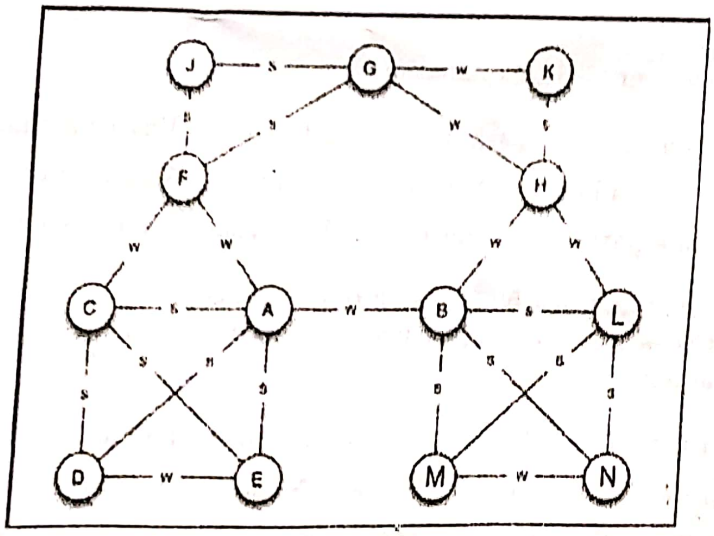
7. Suppose you're working with a group of researchers studying social communication networks, with a particular focus on small-world phenomenon.

   The research group is currently negotiating an agreement with a large mobile phone carrier to get a snapshot of their who-calls-whom graph. Specifically, under a strict confidentiality agreement, the carrier is offering to provide a graph in which there is a node representing each of the carriers customers, and each edge represents a pair of people who called each other over a fixed one-year period. (The edges will be annotated with the number of calls and the time at which each one happened. No personal identification will be provided with the nodes.)

   But recently, the carrier has proposed that instead of providing all the data, they'll only provide edges corresponding to pairs of people who called each other at least once a week on average over the course of the year. (That is, all nodes will be present, but there will only be edges for pairs of people who talked at least 52 times.) The carrier understands that this is not the full network, but they would prefer to release less data and they argue that this will be a good approximation to the full network.

   Your research group objects, but the carrier is not inclined to change its position unless your group can identify specific research findings that are likely to be misleading if they are drawn from this reduced dataset. The leader of your research group asks you to prepare a brief response to the carrier, identifying some concrete ways in which misleading conclusions might be reached from the reduced dataset. What would you say in your response? (5)

8. Consider the graph $H$ given below. All the edges are labeled as either strong or weak.




Find a local bridge in the above figure and substantiate why it is a local bridge. Is there any other local bridge in $H$? If the edge $AB$ becomes strong what are the implications? Explain briefly. (2+3)

All the best!