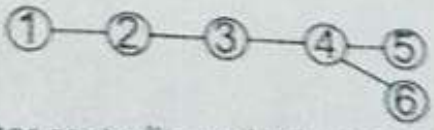
M.Sc. Computer Science
MCSE 303: Network Science
Unique Paper Code: 223412303
Semester III
December 2024
Year of admission: 2023

Time: Three Hours

Max. Marks: 70

Note: All questions are compulsory. Attempt all the parts of a question together.

1. Consider the following undirected network and answer the questions given below: 8+3+4



A). Define eigenvector centrality and calculate it for the given network.
B). Compute the degree distribution of the given network.
C). Determine the average clustering coefficient of the given network.

2. A). Describe the Binomial and Poisson degree distributions for random networks. Discuss their limitations. 6

B). Consider a network where each node has degree k = 2 and clustering coefficient C = 1. How does the network look like? What condition does number of nodes (N) satisfy in this case? 4

3. A). Define the probability of a random network having exactly L links. Compute the expected number of links in a random graph with an example. 5

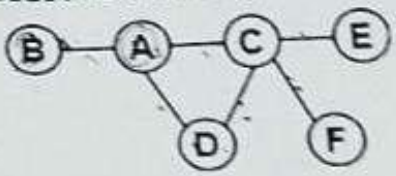
B). Explain the concept of six degrees of separation within the context of the Small World phenomenon. Demonstrate this using an example of a random network with an average degree. 5

4. A). Define the Power-Law distribution (Discrete Formalism) and explain how it differs from the Poisson distribution.

B). Describe the steps for generating a scale-free network using the Barabási-Albert (BA) Model.

5. Calculate the following centrality measure on the given network. 4+

A). Betweenness Centrality
B). Closeness Centrality
C). Degree Centrality



6. Perform Average-link agglomerative community detection algorithm. Also, show the step-wise construction of the dendrogram. 7

Data Points	X1	X2
A	7	2
B	9	13
C	2	11
D	8	2
E	3	12
F	5	5

7. Explain the Girvan-Newman algorithm. Show the steps for identifying communities in the given network using the Link-Betweenness-based Girvan-Newman algorithm. 8