

## JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

## TEST -3 EXAMINATIONS- 2026

## B.Tech-VIII Semester (CSE/IT)

COURSE CODE (CREDITS):18B1WCI847(3)

MAX MARKS: 35

COURSE NAME: SOCIAL AND INFORMATION NETWORK ANALYSIS

COURSE INSTRUCTOR: SEEMA RANI

MAX. TIME: 2 Hours

**Note:** (a) All questions are compulsory.

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

(c) Use of calculator is allowed

| Q.No | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CO                  | Marks   |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------|
| Q1   | <p>A university is analyzing student interactions across departments to understand communication patterns.</p> <p>(a) Explain how the same system can be studied at different levels of network analysis</p> <p>(b) Explain how their eccentricity differs and what this implies about their position in the network.</p>                                                                                                                                                                                                              | CO1,<br>CO2,<br>CO3 | 2.5+2.5 |
| Q2   | <p>A network is represented by the adjacency matrix:</p> $A = \begin{bmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 2 \end{bmatrix}$ <p>(a) Determine the characteristic equation of the matrix.</p> <p>(b) Compute the eigenvalues and identify the principal eigenvalue.</p> <p>(c) Find the corresponding eigenvector for the principal eigenvalue.</p> <p>(d) Normalize the eigenvector and interpret it as eigenvector centrality scores.</p> <p>(e) Based on the result, explain whether all nodes are equally important or not.</p> | CO5,<br>CO6         | 5       |
| Q3   | <p>A researcher claims: "Students who are more central in a friendship network tend to perform better academically."</p> <p>(a) Classify this hypothesis and justify your reasoning.</p> <p>(b) Describe how a permutation test would evaluate this claim, including what is being randomized and why?</p> <p>(c) A network has 15 nodes divided into 3 components of sizes</p>                                                                                                                                                        | CO5,<br>CO6         | 1+2+2   |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |                |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------------|
|           | [6, 5, 4]. Compute the fragmentation ratio.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                              |                |
| <b>Q4</b> | <p>Given network:<br/>A–B, A–C, B–C, B–D, C–D, D–E</p> <p>(a) Compute degree centrality of all nodes<br/>(b) Compute closeness centrality of node D<br/>(c) Compute betweenness centrality of node D<br/>(d) Compute the eccentricity of node D<br/>(e) interpret what it tells about its position in the network.</p>                                                                                                                                                                                                                                | <b>CO5,<br/>CO6</b>          | <b>5</b>       |
| <b>Q5</b> | <p>A network analyst observes that two nodes are not directly connected but can influence each other through intermediaries.</p> <p>(a) Distinguish whether the sequence <math>A \rightarrow B \rightarrow C \rightarrow A</math> is a walk, trail, or path, and justify.<br/>(b) Two nodes have identical degree but belong to different parts of the network (one in a dense cluster, one on the boundary). Explain how their positions in the graph differ despite having the same degree.</p>                                                     | <b>CO1,<br/>CO2,<br/>CO3</b> | <b>2.5+2.5</b> |
| <b>Q6</b> | <p>Your team collects interaction data using surveys and digital logs, but the network visualization in Gephi shows unexpected isolated nodes and missing connections.</p> <p>(a) Explain how improper formatting of node/edge data can distort network measures.<br/>(b) Suggest a systematic approach to prepare and validate data before importing into Gephi.<br/>(c) A network consists of 12 nodes divided into 4 components of sizes [4, 3, 3, 2]. Compute the component ratio and interpret what it indicates about the network structure</p> | <b>CO1,<br/>CO3,<br/>CO4</b> | <b>1+1+3</b>   |
| <b>Q7</b> | <p>A company network shows two highly connected departments linked only through one employee. The organization wants to analyze influence and predict future collaborations.</p> <p>(a) Explain steps to import and visualize network in Gephi<br/>(b) Identify structural holes and brokerage roles in a network.<br/>(c) Explain when to use SIENA vs ERGM models.<br/>(d) Analyze whether the ties in each department are Simmelian ties, and explain how they affect group cohesion.</p>                                                          | <b>CO5,<br/>CO6</b>          | <b>1+1+2+1</b> |