NIRMA UNIVERSITY

Institute:	Institute of Technology, School of Technology
Name of Programme:	MTech CSE (Data Science)
Course Code:	6CS472ME25
Course Title:	Social Network Analytics
Course Type:	Department Elective-III
Year of Introduction:	2025-26

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Course Learning Outcomes (CLO):

At the end of the course, the students will be able to:

1. explain the intricacies and anomalies of social network structures (BL2)
2. apply network growth and link analysis models for social network (BL3)
3. identify communities and cascade behaviors in communities (BL3)
4. build graph learning-based social network applications. (BL6)

Unit	Contents	Teaching Hours (Total 45)
Unit-I	**Introduction, Network Measures, and Network Growth Models:** Definition, Need, Applications, Preliminaries, Graph Visualisation Tools, Network Measures: Basics, Node Centrality, Assortivity, Transitivity and Reciprocity, Similarity, Degeneracy, Properties of Real-World Networks, Random Network Model, Ring Lattice Network Model, Watts–Strogatz Model, Preferential Attachment Model, Price's Model, Local-world Network Growth Model, Network Model with Accelerating Growth, Aging in Preferential Attachment	07
Unit-II	**Link Analysis and Link Prediction:** Applications of Link Analysis, Signed Networks, Strong and Weak Ties, Link Analysis Algorithms, PageRank, Personalised PageRank, DivRank, SimRank, PathSIM, Applications of Link Prediction, Temporal Changes in a Network, Problem Definition, Evaluating Link Prediction Methods, Heuristic Models, Probabilistic Models, Supervised Random Walk, Information-theoretic Model, Latest Trends in Link Prediction	08
Unit-III	**Community Structure in Networks:** Applications of Community Detection, Types of Communities, Community Detection Methods, Disjoint Community Detection, Overlapping Community Detection, Local Community Detection, Community Detection vs Community Search, Evaluation of Community Detection Methods	08

Unit-IV	**Cascade Behaviours and Network Effects:** Preliminaries and Important Terminologies, Cascade Models, Case Study – The "Indignados" Movement, Probabilistic Cascades, Epidemic Models, Independent Cascade Models, Cascade Prediction	07
Unit-V	**Anomaly Detection in Networks**: Outliers versus Network-based Anomalies, Challenges, Anomaly Detection in Static Networks, Anomaly Detection in Dynamic Networks	07
Unit-VI	**Graph Representation Learning**: Machine Learning Pipelines, Intuition Behind Representation Learning, Benefits of Representation Learning, Criterion for Graph Representation Learning, Graph Representation Learning Pipeline, Representation Learning Methods	08

Self-Study:

The self-study contents will be declared at the commencement of the semester. Around 10% of the questions will be asked from self-study content.

Suggested Readings/ References:

1. Stanley Wasserman, Katherine Faus, Social Network Analysis: Methods and Applications, Cambridge University Press
2. Tanmoy Chakraborty, Social Network Analysis, Wiley
3. Albert-Lazzlo Barabasi, Network Science, Cambridge University Press.

Suggested List of Experiments:

Sr.	Name of Experiments/Exercises	Hours
1	Use network visualization tools to compute degree distribution, clustering coefficient, and shortest path	02
2	Calculate node centrality measures like degree, betweenness, closeness, and eigenvector. Also, the most influential nodes will be identified using different centrality metrics	02
3	Implement and compare network growth models and analyze how network structure changes over time	02
4	Implement and compare PageRank, Personalised PageRank, and SimRank algorithms to rank web pages	04
5	Apply community detection algorithms (Louvain, Girvan-Newman) on real-world datasets. Evaluate the quality of detected communities using modularity scores	04
6	Implement heuristic-based link prediction models (Common Neighbors, Jaccard, Adamic-Adar) and evaluate the accuracy of link prediction using precision and recall	02
7	Simulate the Independent Cascade Model (IC) and Linear Threshold Model (LT). Also, observe how information spreads through a network and identify influential nodes	04
8	Detect anomalies in static and dynamic networks using outlier detection techniques. Also, apply anomaly detection on real-world datasets such as fraud detection in financial transactions.	02
9	Implement node embedding techniques like DeepWalk or Node2Vec. Also, visualize embeddings and use them for classification tasks	02
10	Perform an end-to-end analysis on a large-scale dataset. Apply link analysis, community detection, and link prediction to extract meaningful insights.	06