



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Artificial Intelligence and Data Science

Subject Code: ME02095041

Course/Subject Name: Graphs Processing & Algorithms

WEF Academic Year	2024-25
Semester	2
Category of the Course	Professional Elective Course

Prerequisite:	Basic knowledge of data mining and machine learning concepts, as well as R, SAS, statistics, linear algebra, and programming in C/C++ and Java.
Rationale:	<ul style="list-style-type: none">The course will explore the different methods and techniques for graph mining and analytics.The course will focus to conceptualize and design efficient and effective graph mining solutions for different real world problems. The course will also cover the different graph algorithms which are used in real time applications.

Course Outcome:

After completion of the Course, Students will be able to:

No	Course Outcomes	RBT Level*
01	Understand the concepts of graphs theory.	UN
02	Apply the graph algorithms to analyze large-scale datasets in different domains.	AP
03	To formulate and solve graph-related problems,	AP
04	To analyse different models & techniques for web mining.	AN
05	To evaluate the different real time applications algorithms for graph analytics.	EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create



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Teaching and Examination Scheme:

Teaching Scheme (in hours)			Total Credits (L+T+PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial/Practical		
				ESE (E)	PA/CA (M)	PA/CA (I)	ESE (V)	
03	00	02	04	70	30	20	30	150

Course Content:

Unit	Course Content	No of Hours	% of Weightage
1	Unit-I: Introduction to graphs What Are Graphs? What Are Graph Analytics and Algorithms? Graph Processing, Databases, Queries, and Algorithms, Graph Types and Structures, Random, Small-World, Scale-Free Structures, OLTP and OLAP, Why Should We Care About Graph Algorithms?, Graph Analytics Use Cases	04	10
2	Unit-II: Graph Platforms and Processing Platform Considerations, Processing Considerations, Representative Platforms-Selecting Our Platform, Apache Spark, Neo4j Graph Platform	04	10
3	Unit-III: Path Finding and Graph Search Algorithms Importing the Data into Apache Spark, Importing the Data into Neo4j, Breadth First Search with Apache Spark, Shortest Path , Shortest Path (Weighted) with Apache Spark, All Pairs Shortest Path, Single Source Shortest Path, Minimum Spanning Tree, Random Walk.	06	15
4	Unit-IV: Centrality Algorithms Example Graph Data: The Social Graph, Degree Centrality, Closeness Centrality, Betweenness Centrality, PageRank.	07	15



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5	Unit-V: Community Detection Algorithms Example Graph Data: The Software Dependency Graph, Triangle Count and Clustering Coefficient, Strongly Connected Components, Connected Components, Label Propagation, Louvain Modularity.	09	20
6	Unit-IV: Graph Algorithms in Practice Analyzing Yelp Data with Neo4j, Analyzing Airline Flight Data with Apache Spark, Graphs and Machine Learning in Practice: Link Prediction- Tools and Data, Importing the Data into Neo4j, The Coauthorship Graph, Creating Balanced Training and Testing Datasets, How We Predict Missing Links, Creating a Machine Learning Pipeline, Predicting Links: Basic Graph Features, Predicting Links: Triangles and the Clustering Coefficient, Predicting Links: Community Detection.	09	20
7	Unit-VII : Current Trends The latest technology and algorithms in real time applications like Netflix, Facebook, Gmail with web analytics.	06	10
TOTAL		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	20	20	20	10

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

Reference/Suggested Learning Resources:

(a) Books:

1. Graph Algorithms by Mark Needham, Amy E. Hodler Publisher(s): O'Reilly Media, Inc.
2. Han and M. Kamber, Data mining–Concepts and Techniques, 2nd Edition, Morgan kaufman Publishers, 2006.
3. Practical Text Mining and Statistical Analysis for Non-structured Text Data Applications, 2012.



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4. Bing Liu, Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, Springer publishing, 2009.

(b) Open source software and website

- Course-related online MOOCs on NPTEL/SWAYAM platform.
- Recently Published papers/articles in reputed journals.

Suggested Course Practical List:

- The practical work will be carried out based on the content covered during the academic sessions.

List of Laboratory/Learning Resources Required: Programming development environment (open source is encouraged) related to the course content.

Suggested Project List: The subject teacher has to assign the relevant outcome based project work to the students in individual/team.

Suggested Activities for Students: The subject teacher has to assign the outcome based activities to the students in individual/team.
