NITDGP/BTECH/Reg/Odd/2023-24
Mid Term Examination, 2023-24

Course Code: CSE710 **Full Marks: 25**
Course Name: Machine Learning **Time: 90 Minitues**

Instruction: Answers any five questions.

Q. No.	Body of Question	Marks	Mapped CO
1	Derive the update rule for linear regression.	5	CO1, CO2
2	Derive the update rule for logistic regression.	5	CO4
3	Why clustering is an unsupervised learning? What is the importance of clustering algorithms?	5	CO1, CO3
4	Compare between partition, hierarchical and density based clustering. What is the difference between hard and soft clustering?	5	CO1, CO3
5	Consider the set of two-dimensional patterns $\{(1,1),(1.5,2),(3,4),(5,7),(3.5,5),(4.5,5),(3.5,4.5)\}$. Use single-link agglomerative clustering to draw the dendogram.	5	CO2, CO3, CO5
6	If there is a set of n patterns and it is required to cluster these patterns to form two clusters, how many such partitions will there be? What is the advantage of considering mediod over mean as cluster center in partition clustering?	5	CO1, CO3

Course Outcomes:
CO1: Understanding of the basic concepts, fundamental issues and challenges of machine learning.
CO2: Comprehend the principle and techniques of supervised learning.
CO3: Explain the basic concepts and techniques of unsupervised learning.
CO4: Understanding of the basic concepts and challenges of machine learning.
CO5: Ability to apply the concepts of machine learning in different domains.

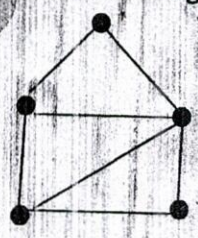
NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

Course Code: CSE 711
Course Name: GRAPH THEORY

Full Marks: 25
Time: 90 Minutes

Instructions: ANSWER ALL QUESTIONS FROM GROUP A AND ANSWER ANY THREE QUESTIONS FROM REST
Materials to be supplied: Graph paper shall be supplied, if required.

Question No.	Body of the Question	Marks	Mapped CO
GROUP A	1. A tree T has one vertex of degree 6, three vertices of degree 4, and two vertices of degree 3. How many leaf nodes does T have?	2	CO1, CO2, CO3
	2. A connected plane graph G has 10 vertices and 20 edges. Compute the number of faces in the dual graph G* of G.	2	
	3. Show that any planar graph G with $\delta(G) \geq 5$ must have at least 12 vertices.	2	
	4. Find the diameter, radius, and center of the graph $C_3 \times P_3$.	2	
	5. Using Havel Hakimi theorem, verify whether the given sequence S = [2, 2, 2, 2,4, 4] is degree sequence or not.	2	
2	Use induction to establish Euler's formula for the number of edges, vertices and faces of a planar drawing of a graph. Then show that for an n ($\geq$ 3)-vertex graph, the number e of edges is at most 3n − 6.	5	CO3
3	Prove that a simple graph with n vertices and k components can have at most (n − k) (n − k+1)/ 2 edges.	5	CO1
4	How many different labeled spanning trees are there in K_7? Construct a labeled tree corresponding to the Prüfer code (2, 3, 2, 3, 2, 3, 2, 3). Show your steps.	1+4	CO2
5	State Kirchoff matrix tree theorem. Also, find the number of spanning trees in the following graph using the Kirchoff matrix tree theorem. 	5	CO2

Course Outcomes
CO1:
CO2:
CO3:

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR
Odd Semester Mid-Term Examination, 2023-24

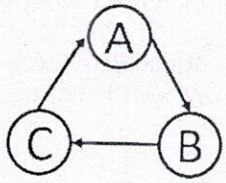
Course Code: CSE716
Course Name: Data Analytics
Question Paper No.: NITDGP/CSE716/01

Full Marks: 25
Time: 90 Minutes
Date of Exam:

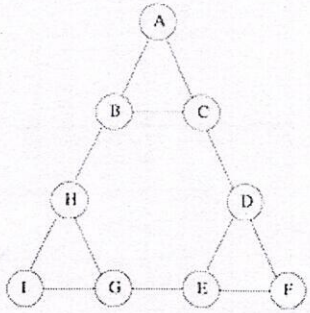
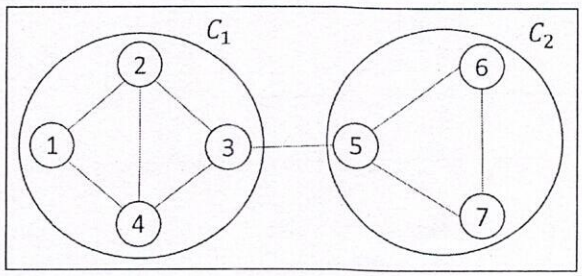
Instructions: Answer any 5 questions.
Materials to be supplied: N/A

Question No.	Body of the Question	Marks	Mapped CO
1	(a) Hows does Collaborative Filtering works? What metrics can be used to evaluate a Collaborative filtering model? (b) Given a user-item ratings matrix below, where 4 users (rows) have rated 4 items (columns). User-item ratings matrix Find the most similar user of U_3	2 + 3	CO3
2	(a) Explain the Page Rank Algorithm from linear system point of view. (b) In the graph shown in Figure 1, assume that the current PageRank values of A, B and C are 0.2, 0.4 and 0.4 respectively. What will be their PageRank values after one iteration? Figure 1: The Graph	2 + 3	CO2
3	Use the Girvan-Newman approach to find the number of shortest paths from node A that pass through each of the edges.	5	CO2

	I_1	I_2	I_3	I_4
U_1	2	0	3	4
U_2	1	3	2	0
U_3	2	0	3	4
U_4	2	1	0	3



Course Outcomes
CO1: Classify the labelled dataset into different classes and group the unlabelled dataset into different clusters by uncovering hidden patterns and correlations among them.
CO2: Model a problem into a graph database after absorbing and connecting a large volume of data and performing the analytical task over the graph.
CO3: Develop a recommendation system by predicting users' preferences based on similarity measures and evaluating its performance using the metrics such as Precision, recall, and F1-score.
CO4: Understand and set up the Hadoop framework, which will allow them to efficiently manage and process big data in a distributed computing environment and understanding the importance of Big Data Analytics in E-commerce, Agriculture etc.

			
4	Consider the social network provided in Figure 2. Given the community structures C_1= {1, 2, 3, 4}, C_2= {5, 6, 7}. Calculate Modularity of the social network.  Figure 2: Social network	5	CO1, CO2
5	Suppose we have a data set with five predictors, X1 = GPA, X2 = IQ, X3 = Gender (1 for Female and 0 for Male), X4 = Interaction between GPA and IQ, and X5 = Interaction between GPA and Gender. The response is starting salary after BTech (in thousands of rupees). Suppose we use least squares to fit the model, and get β^0 = 50, β^1 = 20, β^2 = 0.07, β^3 = 35, β^4 = 0.01, β^5 = −10. (a) Which answer is correct, and why? (i) For a fixed value of IQ and GPA, males earn more on average than females. (ii) For a fixed value of IQ and GPA, females earn more on average than males. (iii) For a fixed value of IQ and GPA, males earn more on average than females provided that the GPA is high enough. (iii) For a fixed value of IQ and GPA, females earn more on average than males provided that the GPA is high enough. (b) Predict the salary of a female with IQ of 110 and a GPA of 4.0. (c) True or false: Since the coefficient for the GPA/IQ interaction term is very small, there is very little evidence of an interaction effect. Justify your answer.	2+2+1	CO1
6	Write short notes on: (i) Centrality (ii) Clustering Coefficient (iii) Community Structure	2+2+1	CO1, CO2
7	How you can use Linear Regression for binary classification?	5	CO1

NITDGP/BTECH/Reg/Odd/2023-24

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR
Odd Semester Mid-term Examination, 2023-24

Course Code: CSE 718 Full Marks: **25**

Course Name: Cryptography and Network Security Time: **90 Mins**

Question Paper No.: **NITDGP/CSE718** Date of Exam: **11/09/2023**

Instructions: Answer all the questions.
Materials to be supplied: Graph paper shall be supplied, if required.

Question No.	Body of the Question	Marks	Mapped CO
1	Briefly explain the different network security services.	3	CO1
2	Explain different cryptanalysis attacks.	3	CO4
3	Distinguish between active attack and passive attack	2	CO1
4	Find the multiplicative inverse of x^5 modulo $(x^8+x^4+x^3+x+1)$ for the Field $F(2^8)$ using extended Eucliden algorithm.	4	CO4
5	Calculate number of possible keys for the affine cipher (a classical cipher).	3	CO1
6	Given the simultaneous equation $x \equiv 3 \; mod \; 5$ $x \equiv 5 mod \; 7$ Applying CRT to find the unique solution of $x \in Z_{35}$	3	CO1
7	Point out the basic differences between "information theoretic security" and "computationally bounded security"	2	CO2
8	Let P1 = 17 and P2 = 23 are the two prime numbers. Compute an instance of RSA key pair with above primes.	3	CO3
9	Find the Legendre symbol $\left(\frac{24}{53}\right)$.	2	CO1

Course Outcomes

CO1: Introduce to the basic mechanisms of Cryptography.
CO2: Notion of computationally hard problems and their applications.
CO3: Notion of trap-door and one-way functions and their applications.
CO4: The attack and crypto-analysis.
CO5: Ability to design secure protocols and their vulnerability analysis.

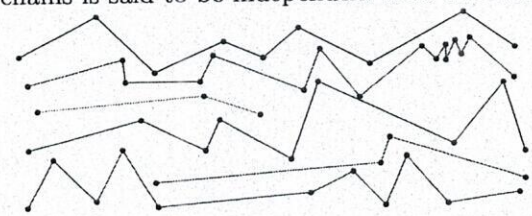
NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR
Even Semester Mid-Term Examination, 2023-'24

Course Code: CSE721 Full Marks: 25
Course Name: Computational Geometry Time: 1.5 Hours

Instructions: i. Answer **one** question from **Section A** and **one** question from **Section B**.

Section A (answer any one)

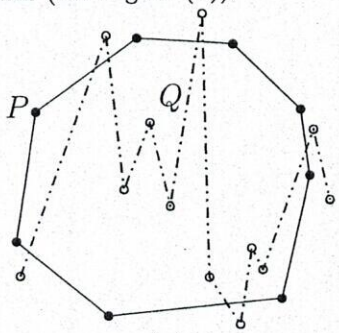
Question No.	Body of the Question	Marks	Mapping CO
1.	A polygonal chain in the plane is a sequence of vertices $C = \{p_1, \ldots, p_n\}$, where each consecutive pair $(p_i, p_{(i+1)})$ is connected by a line segment, called an edge. Such a chain is said to be strictly horizontally monotone if any vertical line intersects the chain at a single point. A collection of chains is said to be independent if no two intersect each other.	10	CO3



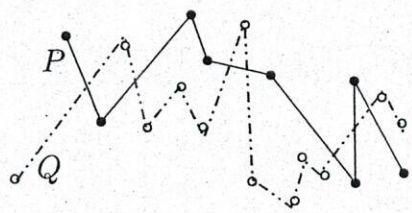
A collection of monotone chains

Present an algorithm which, given a set of k strictly monotone polygonal chains $C = \{C_1, \ldots, C_k\}$, determines whether they are independent. Your algorithm does not need to report the intersections; it just needs to indicate whether any intersection exists. Assume that n_i denotes the number of vertices in the ith chain, and let $n = \sum_{i=1}^{k} n_i$ be the total size of all the chains. Your algorithm should run in $O(n \log k)$ time.
(Hints: Use plane sweep, but do it efficiently.)

2.	Show that the space complexity of an Interval tree of n intervals is $O(n)$.	10	CO1
3.	For this problem give an exact bound for full credit and an asymptotic (big-Oh) bound for partial credit. Assume a general position. [a] You are given a convex polygon P in the plane having n_P sides and an x-monotone polygonal chain Q having n_Q sides (see Figure (a)). What is the maximum number of intersections that might occur between the edges of these two polygons? [b] Same as (a), but P and Q are both polygonal chains that are monotone with respect to the x-axis (see Figure (b)).	(5 + 5)	CO1, CO2



(a)



(b)

Section B (answer any one)

Question No.	Body of the Question	Marks	Mapping CO
4.	Let S be a set of n axis-parallel rectangles in the plane. We want to be able to report all rectangles in S that are completely contained in a query rectangle $[x : x'] \times [y : y']$. Describe a data structure for this problem that uses $O(n \log^3 n)$ storage and has $O(\log^4 n+k)$ query time, where k is the number of reported rectangles. (Hints: Transform the problem to an orthogonal range searching problem in some higher dimensional space.)	15	CO1
5.	We are given a set $P = \{p_1, p_2, \ldots, p_n\}$ of n points in the plane. Describe an output-sensitive algorithm to compute the convex hull of P. For full credit, your algorithm should run in better than $O(n \log n)$ time, taking the size of output into consideration.	15	CO1, CO2

Date: 19th September 2023

Course Outcomes

CO1 To demonstrate familiarity with some of the basic algorithmic techniques of the area.

CO2 To design and analyze "new" geometric algorithms and to derive the lower bound for some geometric problems.

CO3 To map practical problems to computational geometric problems and find a solution to these geometric problems helps to solve a wide range of practical problems in a variety of fields such as graphics, robotics, databases, and sensor networks.

CO4 To develop skills to work on geometrical manipulating software and to demonstrate acquaintance with modern research in the field.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

Course Code: CSE726
Course Name: INCENTIVE MECHANISMS IN COMPUTER SCIENCE
Question Paper No: NITDGP/CSE726/8)

Full Marks: 25
Time: 90 Minutes
Date of Exam: 13/09/2023

Instructions: Answer question of no 1 and any three from the rest. Different parts of a question must be written consecutively.

Question No.	Body of the Question	Marks	Mapped CO
1	Consider a case of sponsored search auction for two slots and three advertisers. The bidders' valuations per click are 15, 10 and 5, respectively. The click-through rates of slot 1 and slot 2 are 90 and 60 respectively. Calculate total revenue earned by the auctioneer under both GSP and VCG separately.	10	CO2, CO3
2	Consider the following mechanism for course allocation • Students are ranked ($1, 2, \ldots, n$) according to CGPA/Gate Score. • Each student submits a ranked list of at most k (some constant) courses, out of total m available courses • For $i = 1, 2, \ldots, n$: Student ranked i is assigned to her favourite choice among the options still available If none of her k options are still available, the least popular course is assigned to the student. Is the above mechanism *strategyproof*? If yes, then give a formal proof. Otherwise, provide a counterexample.	5	CO1, CO4
3	Say, in the market there are lots of participants. Do you think, that thinness problem can still be there? Justify with an example. In this case what solution can be proposed? What are the causes of market failure? Illustrate with examples	3+2	CO2, CO3
4	What do you mean by Condorcet winner? Give an example. Does the Ranked choice voting rule satisfy the Condorcet condition? If yes, then give a formal proof or give a counterexample (i.e., a set of votes where there is a Condorcet winner a* and the Ranked choice rule elects an alternative other than a*).	5	CO1, CO4
5	Say, there are k service providers $S = \{s_1, \ldots, s_k\}$ and there are n agents (either a buyer or a seller) $N = \{n_1, \ldots, n_k\}$ participating in a system. Consider that $N_i \subseteq N$ agents are associated with s_i service provider and $\sum_{i=1}^{k} N_i = N$. Transaction in the system happens with first come first serve basis. Do you think that if an information is reached little bit earlier to the agents N_i associated with the service provider s_i than to the agents N_j associated with the service provider s_j, can have a significant impact in some cases? If so justify your statement with an example. How can you solve this problem?	3+2	CO1, CO4

Course Outcomes
CO1: Can have the efficiency to think about incentive issues in computation
CO2: Can learn the tools to tackle the incentive issues.
CO3: Can understand the modern state of the art of incentive based computation.
CO4: Can analyze the scenarios of incentive based computation.