JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

B.Sc-V Semester (Maths.)

COURSE CODE (CREDITS):18B1WCI634(2) MAX. MARKS: 35

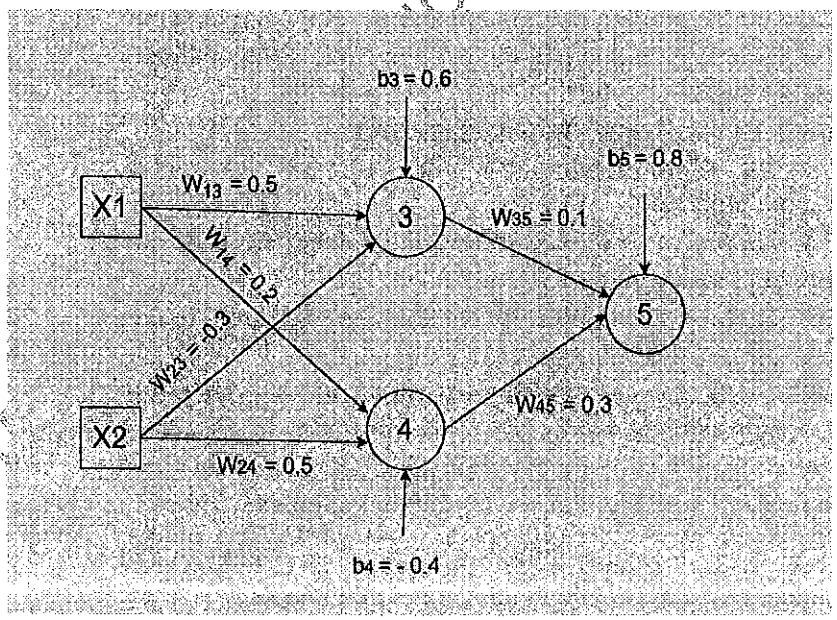
COURSE NAME: Machine Learning

COURSE INSTRUCTORS: SKP MAX. TIME: 2 Hours

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

(b) The calculator is allowed.

Q.No	Question	CO	Marks
Q1	Suppose a genetic algorithm uses chromosomes of the form x = ***abcdefgh*** with a fixed length of eight genes. Each gene can be any digit between 0 and 9. Let the fitness of individual x be calculated as: f(x) = (a + b) − (c + d) + (e + f) − (g + h) , and let the initial population consist of four individuals with the following chromosomes: x1 = 6 5 4 1 3 5 3 2, x2 = 8 7 1 2 6 6 0 1, x3 = 2 3 9 2 1 2 8 5, x4 = 4 1 8 5 2 0 9 4 1. Evaluate the fitness of each individual, showing all your workings, and arrange them in order with the fittest first and the least fit last. 2. Perform the following crossover operations: i) Cross the fittest two individuals using one–point crossover at the middle point. ii) Cross the second and third fittest individuals using a two–point crossover ***(points b and f).*** iii) Cross the first and third fittest individuals (ranked 1st and 3rd) using a uniform crossover. 3. Suppose the new population consists of the six offspring individuals received by the crossover operations in the above question. Evaluate the fitness of the new population, showing all your workings. Has the overall fitness improved?	4	10
Q2	For the given data, compute two clusters using K-means algorithm for clustering where initial cluster centers are (1.0, 1.0) and (5.0, 7.0). Execute for 1 iteration. **(Record Number, A ,B) = (R1 ,1.0 ,1.0), (R2, 1.5, 2.0), (R3, 3.0, 4.0), (R4, 5.0, 7.0) , (R5 ,3.5, 5.0) , (R6 ,4.5, 5.0), (R7 , 3.5 , 4.5)**	4	5

Q3	Consider the following training data set of (seven) points X's in a plane and their binary class label y's: **X : (1, 0) (0, 1) (0, -1) (-1, 0) (0, 2) (0, -2) (-2, 0) ; y : -1 -1 -1 +1 +1 +1 +1.** We perform the following non-linear transform of the input vector X = (x1, x2) to obtain the transformed feature vector Z = (z1, z2) = (ϕ1(X), ϕ2(X)), with ϕ1(X) = x2 2 -2x1 +3, ϕ2(X) = x1 2 - 2x2 -3. Write the equation of the optimal separating hyperplane in transformed space Z.	5	5
Q4	You are given the following training dataset of points in 2D space with binary classes. Apply KNN algorithms. (X,Y,Class)=(1, 2, +1), (2, 3, +1), (3, 3, -1),(5,4,-1), (3, 5, +1) 1. Predict the class of the new point (3,2) using k = 3 and Euclidean distance.Show all distance calculations step by step. 2. Explain your reasoning for the predicted class.	5	5
Q5	Consider a multilayer feed-forward neural network given below. Let the learning rate be 0.5. Assume initial values of weights and biases as given in the table below. Train the network for the training tuples (1, 1, 0), where last number is target output. Show weight and bias updates by using back-propagation algorithm. Assume that sigmoid activation function is used in the network.  	3	10

Best of luck