5. (a) Define density-based connectedness.

   (b) Apply DBSCAN on the following set of data points, to determine the clusters. Show all steps in detail, assuming *eps* = 1 and *minPts* = 2.
   Data Points: (3,0), (3,1), (3,2), (4,1), (4,2), (10,11), (10,10), (20,21), (20,22), (21,21), (21,22).

3 + 9 = 12

Group - D

6. (a) Write short notes on the followings:
   i. Growth function
   ii. Break point.

   (b) Calculate growth function and break point for the set of N points for the following functions.
   i. Positive intervals
   ii. Convex sets.

4 + (4 + 4) = 12

7. (a) How hypotheses and growth functions are related?

   (b) Find the growth function for positive ray based classification.

   (c) Derive the formula for multivariate linear regression.

4 + 4 + 4 = 12

Group - E

8. Construct the primal problem and then derive the Lagrangian and its dual for the optimization problem as defined by linear SVM – classification.

12

9. (a) Write Mercer's condition in selecting Kernel function for nonlinear SVM.

   (b) Write short notes on any three of the followings:
   i. Information measure
   ii. Overfitting
   iii. VC Dimension
   iv. Error vs Noise
   v. Bias-Variance tradeoff .

12

MACHINE LEARNING
(CSEN 5131)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) Consider the following data set, where A and B are input.

A	0	0	1	1
B	0	1	0	1
output	-1	+1	+1	-1

   Minimum training error can be achieved by
   (a) Single Layer Perceptron (b) SVM (Quadratic Kernel)
   (c) Both (a) and (b) (d) Neither (a) nor (b).

   (ii) Which of the following is a predictive model?
   (a) Clustering (b) Regression
   (c) Summarization (d) Association Rule.

   (iii) Consider the following two statements:
   (x) "Noise objects are always outliers".
   (y) "Outliers are always noise objects".
   (a) Both are true (b) (x) is true and (y) is false
   (c) (x) is false and (y) is true (d) Both are false.

   (iv) Clustering can be categorised as a problem of _____.
   (a) supervised learning (b) unsupervised learning
   (c) reinforcement Learning (d) none of these.

   (v) Gradient descent approach has the problem of stuck into _____.
   (a) global minima (b) infinite oscillation
   (c) local minima (d) either (b) or (c).

(vi) Back propagation is a learning technique that adjusts weights in the neural network by propagating weight changes
(a) Forward from source to sink
(b) Backward from sink to source
(c) Forward from source to hidden nodes
(d) Backward from sink to hidden nodes.

(vii) Multi Layer Perceptron can be used as
(a) a classifier (b) an estimator
(c) None of (a) and (b) (d) both (a) and (b).

(viii) Multi layered perceptron model is used to classify
(a) linearly separable classes of data
(b) non-linearly separable classes of data
(c) both (a) and (b)
(d) none of these.

(ix) Generalization error is known as
(a) in sample error (b) training error
(c) out of sample error (d) none of these.

(x) In non-linear SVM, the kernel function $K(x_i, x_j)$ has to satisfy the followings:
(a) $K(x_i, x_j)$ is positive semi definite (b) $K(x_i, x_j)$ is symmetric
(c) Both (a) and (b) (d) none of the above.

Group - B

2. (a) Discuss the back propagation learning algorithm for a single layer artificial neural network using an appropriate example.

(b) How does stochastic gradient descent differ from standard gradient descent?

(c) "Gradient descent technique always ensures global optima"—Argue in favour or against this statement.

6 + 3 + 3 = 12

3. (a) Explain the working principle of Naïve Bayes classification technique.

(b) Find the Class(X) using Naïve Bayes on the following dataset, where X= (Age<30; Income=High ; Student=No ; Credit Rating= Excellent). Assume there are two classes as follows: one class has bought a laptop and the other did not buy any laptop.

DATASET

Age	Income	Student	Credit_Rating	Buy_Laptop
<30	High	No	Fair	No
<30	High	No	Fair	No
<30	Medium	No	Fair	No
<30	Medium	Yes	Excellent	No
<30	Low	Yes	Excellent	Yes
>40	Medium	No	Fair	Yes
>40	Low	Yes	Fair	Yes
>40	Low	Yes	Excellent	No
>40	Medium	Yes	Fair	Yes
>40	Medium	No	Excellent	No
>30 and <40	High	No	Fair	Yes
>30 and <40	Medium	Yes	Excellent	Yes
>30 and <40	Medium	No	Excellent	Yes
>30 and <40	Low	Yes	Fair	Yes

4 + 8 = 12

Group - C

4. (a) Describe the K-means algorithm.

(b) Perform K-means clustering on all the points in the following table, where K=2. Randomly select the initial seeds and perform the algorithm for two iterations.

Points	X co-ordinate	Y co-ordinate
p1	1	9
p2	2	10
p3	7	4
p4	10	3
p5	5	6
p6	6	11
p7	3	4
p8	4	9
p9	8	1
p10	3	12
p11	7	6
p12	11	2

3 + 9 = 12