FR. Conceicao Rodrigues College Of Engineering

Father Agnel Ashram, Bandstand, Bandra-west, Mumbai-50

Department of Information Technology

B.E. (IT) (semester VII) (2019-2020)

Lesson Plan

Subject: Soft Computing (ITDLO7035)

Credits-4

SYLLABUS

Sr. No.	Module	Detailed Content	CO Mapping
	Prerequisite	Probability and Statistics, C++/Java/ Matlab programming.	
I	Fuzzy Set Theory	Fuzzy Sets: Basic definition and terminology, Basic concepts of fuzzy sets, Fuzzy set operations, Fuzzy relations: Cardinality of fuzzy relations, operations on fuzzy relations, properties of fuzzy relations, Fuzzy Composition Fuzzification and Defuzzification: Features of the membership Functions, Fuzzification, Lambda-Cuts for Fuzzy Sets, Lambda-Cuts for Fuzzy Relations, Defuzzification methods	CO1 CO2
II	Fuzzy Rules, Reasoning, and Inference System	Fuzzy Rules: Fuzzy If-Then Rules, Fuzzy Reasoning Fuzzy Inference System (FIS): Mamdani FIS, Sugeno FIS, Comparison between , Mamdani and Sugeno FIS.	CO1 CO2
III	Neural Network-I	Introduction: What is a Neural network? Fundamental Concepts, Basic Models of Artificial Neural Networks, Arificial Intelligence and Neural Networks, McCulloch-Pitts Neuron Learning: Error-Correction Learning, Memory based Learning, Hebbian learning, Competitive Learning, Boltzmann Learning Perceprton: Perceprton Learning Rule, Perceptron Learning Algorithm, Perceprton Convergence Theorem, Perceptron learning and Non-separable sets.	CO1 CO2
IV	Neural Networks - II	Back propaggation: Multilayered Network Architecture, Back propagation Algorithm, Practical Consideration in impin Implementing the Back propagation Algorithm. Back propagation and XOR problem. Adaptive resonance Theory: Noise-Saturation Dilemma, Solving the Noise-Saturation	CO3 CO6

		Dilemma, Recurrent On-center-Off-surround Networks, Building blocks of Adaptive Resonance, Substrate of resonance, Structural details of the resonance Model, Adaptive Resonance Theory I (ART I), Neurophysiological Evidence for ART Mechanism Character Recognition: Introduction, General Algorithm Architecture for Character Recognition: Binarization, Preprocessing, Filters, Smoothing, Skew Detection and Correction, Slant Correction, Character Normalization, Thinning, segmentation, Multilingual OCR by Rule-Based Approach and ANN Rule-Based Approach: Classification, Tests, Rules Artificial Neural Network: Inputs, Outputs, Identification Results of Multilingual OCR	
05	Genetic Algorithm	An Introduction to genetic Algorithms: What Are Genetic Algorithms? Robustness of Traditional Optimization and Search Methods, The Goals of Optimization, How Are Genetic Algorithms Different from Traditional Methods?, A Simple Genetic Algorithm Genetic Algorithms at Work—a Simulation by hand, Grist for the Search Mill—Important Similarities, Similarity Templates (Schemata), Learning the Lingo. Genetic Algorithms: Mathematical Foundations Who Shall Live and Who Shall Die? The Fundamental Theorem, Schema Processing at Work: An Example by Hand Revisited, The Two-armed and й-armed Bandit Problem, How Many Schemata Are Processed Usefully?The Building Block Hypothesis, Another Perspective: The Minimal Deceptive Problem, Schemata Revisited: Similarity Templates as Hyperplanes, Implementation of a Genetic Algorithm: Data Structures, Reproduction, Crossover, and Mutation, A Time to Reproduce, a Time to Cross, Get with the Main Program, How Well Does it Work? Mapping Objective Functions to Fitness Form, Fitness Scaling, Codings, A Multiparameter, Mapped, Fixed-Point Coding, Discretization, Constraints. Algorithm for Handwriting Recognition Using GA Generation of Graph, Fitness Function of GA: Deviation between Two Edges, Deviation of a Graph, Crossover: Matching of Points, Generate Adjacency Matrix, Find Paths, Removing and Adding Edges, Generation of Graph Results of Handwriting Recognition: Effect of Genetic Algorithms, Distance Optimization, Style Optimization	CO1 CO3 CO6
06	Hybrid Computing	Introduction, Neuro-Fuzzy Hybrid Systems, Adaptive Neuro-Fuzzy Inference System (ANIFS): Introduction, ANFIS Architecture, Hybrid Learning Algorithm, ANFIS as a Universal Approximator, Simulation Examples: Two-input Sinc Function and Three Input Nonlinear Function Genetic Neuro-Hybrid Systems: Properties of Genetic Neuro-Hybrid Systems, genetic Algorithm based Back-propagation Network, Advantages of	CO4 CO6

		Neuro-Genetic Hybrids, Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems Genetic Fuzzy Rule based Systems, Advantages of Genetic Fuzzy Hybrids	

Internal Assessment:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

CO-Statements: Students will be able to:
CO1: List the facts and outline the different process carried out in fuzzy logic, ANN and Genetic Algorithms.
CO2: Explain the concepts and meta-cognitive of soft computing.
CO3: Apply Soft computing techniques the solve character recognition, pattern classification, regression and similar problems.
CO4: Outline facts to identify process/procedures to handle real world problems using soft computing.
CO5: Evaluate various techniques of soft computing to defend the best working solutions.
CO6:Design hybrid system to revise the principles of soft computing in various applications.

CO-PO-PSO Mapping

Course Name	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	1	2	2										1	
CO2	1													
CO3		2	3	2									3	2
CO4		2									2		2	
CO5				2	2								3	
CO6					2								2	2

CO Assessment Tools

CO	**DIRECT METHODS**				**INDIRECT METHODS**
	TEST1	TEST2	ASSIGNMENT1	ASSIGNMENT2	COURSE EXIT SURVEY
CO1	50%	50%	20%	20%	100%
CO2			10%		100%
CO3	30%	30%	50%	50%	100%
CO4	20%	20%			100%
CO5			20%		100%
CO6				30%	100%

Lecture Plan:

Lecture no	Topic	Planned date	Actual Date	Mode of teaching
1	Introduction of soft computing, difference between soft computing and hard computing	02/07/19	03/07/19	black board and chalk
2	Fuzzy Sets: Basic definition and terminology, Basic concepts of fuzzy sets	03/07/19	04/07/19	black board and chalk
3	Fuzzy set operations, Fuzzy relations: Cardinality of fuzzy relations	04/07/19	05/07/19	PPT, black board and chalk
4	operations on fuzzy relations, properties of fuzzy relations	05/07/19	09/07/19	PPT, black board and chalk
5	Fuzzy composition Fuzzification and Defuzzification	9/07/19	10/07/19	PPT, black board and chalk
6	Features of the membership Functions, Fuzzification, Lambda-Cuts for Fuzzy Sets, Lambda-Cuts for Fuzzy Relations	10/07/19	16/07/19	PPT, black board and chalk
7	Defuzzification methods	11/07/19	16/07/19	PPT, black board and chalk
8	Fuzzy Rules: Fuzzy If-Then Rules	12/07/19	17/07/19	black board and chalk
9	Fuzzy Reasoning Fuzzy Inference System (FIS): Mamdani FIS	16/07/19	17/07/19	PPT, black board and chalk
10	FIS example	17/07/19	24/07/19	PPT, black board and chalk
11	FIS example	18/07/19	24/07/19	PPT, black board and chalk
12	Sugeno FIS, Comparison between , Mamdani and Sugeno FIS.	19/07/19	25/07/19	PPT, black board and chalk
13	Introduction: What is a Neural network? Fundamental Concepts	23/07/19	25/07/19	black board and chalk
14	Basic Models of Artificial Neural Networks	24/07/19	31/7/19	black board and chalk
15	Arificial Intelligence and Neural Networks, McCulloch-Pitts Neuron	25/07/19	06/08/2019	black board and chalk
16	Learning:	26/07/19	07/08/19	black board

	Error-Correction Learning, Memory based Learning			and chalk
17	Hebbian learning, Competitive Learning, Boltzmann Learning	30/07/19	08/08/19	black board and chalk
18	Perceprton: Perceprton Learning Rule, Perceptron LearningAlgorithm	31/017/19	09/08/19	black board and chalk
19	Perceprton Convergence Theorem, Perceptron learning and Non-separable sets.	1/08/19	20/08/19	black board and chalk
20	Back propaggation: Multilayered Network Architecture	2/08/19	21/08/19	black board and chalk
21	Back propagation Algorithm,	05/08/19	22/08/19	black board and chalk
22	Practical Consideration in Implementing the Back propagation Algorithm. Back propagation and XOR problem.	06/08/19	23/08/19	black board and chalk
23	Adaptive resonance Theory: Noise-Saturation Dilemma, Solving the Noise-Saturation Dilemma, Recurrent On-center-Off-surround Networks	07/08/19	27/08/19	black board and chalk
24	Building blocks of Adaptive Resonance, Substrate of resonance, Structural details of the resonance Model, Adaptive Resonance Theory I (ART I)	08/08/19	28/08/19	PPT, black board and chalk
25	Character Recognition: Introduction, General Algorithm Architecture for Character Recognition: Binarization, Preprocessing, Filters, Smoothing, Skew Detection and Correction	20/8/19	29/08/19	PPT, black board and chalk
26	Character recognition :Slant Correction, Character Normalization, Thinning, Segmentation	21/8/19	30/08/19	PPT, black board and chalk
27	Multilingual OCR by Rule-Based Approach and ANN Rule-Based Approach: Classification, Tests, Rules Artificial Neural Network: Inputs, Outputs, Identification Results of Multilingual OCR	22/8/19	11/09/19	PPT, black board and chalk
28	An Introduction to genetic Algorithms: What Are Genetic Algorithms? Robustness of Traditional Optimization and Search Methods, The Goals of Optimization, How Are Genetic Algorithms Different from Traditional Methods?,	23/08/19	11/09/19	PPT, black board and chalk
29	A Simple Genetic Algorithm Genetic Algorithms at Work—a Simulation by hand, Grist for the Search Mill—Important	27/8/19	17/09/19	PPT, black board and chalk

	Similarities, Similarity Templates (Schemata), Learning the Lingo.			
30	Genetic Algorithms: Mathematical Foundations Who Shall Live and Who Shall Die? The Fundamental Theorem, Schema Processing at Work	28/8/19	18/09/19	PPT, black board and chalk
31	How Many Schemata Are Processed Usefully? The Building Block Hypothesis, Another Perspective: The Minimal Deceptive Problem, Schemata Revisited: Similarity Templates as Hyperplanes	29/8/19	20/09/19	PPT, black board and chalk
32	Implementation of a Genetic Algorithm: Data Structures, Reproduction, Crossover, and Mutation,	30/8/19	25/09/19	PPT, black board and chalk
33	A Time to Reproduce, a Time to Cross, Get with the Main Program, How Well Does it Work? Mapping Objective Functions to Fitness Form	11/9/19	25/09/19	PPT, black board and chalk
34	Fitness Scaling, Codings, A Multiparameter, Mapped, Fixed-Point Coding, Discretization, Constraints.	12/9/19	26/09/19	PPT, black board and chalk
35	Algorithm for Handwriting Recognition Using GA Generation of Graph, Fitness Function of GA: Deviation between Two Edges	13/9/19	26/09/19	PPT, black board and chalk
36	Deviation of a Graph, Crossover: Matching of Points, Generate Adjacency Matrix, Find Paths, Removing and Adding Edges, Generation of Graph	17/9/19	01/10/19	PPT, black board and chalk
37	Results of Handwriting Recognition: Effect of Genetic Algorithms, Distance Optimization, Style Optimization	18/9/19	04/10/19	PPT, black board and chalk
38	Introduction, Neuro-Fuzzy Hybrid Systems,Adaptive Neuro-Fuzzy Inference System (ANIFS): Introduction, ANFS Architecture	19/9/19	04/10/19	black board and chalk
39	Hybrid Learning Algorithm, ANFIS as a Universal Approximator, Simulation Examples: Two-input Sinc Function and Three Input Nonlinear Function Genetic Neuro-Hybrid Systems	20/9/19	04/10/19	PPT, black board and chalk
40	Properties of Genetic Neuro-Hybrid Systems, genetic Algorithm based Back-propagation Network	24/9/19	09/10/19	PPT, black board and chalk
41	Advantages of Neuro-Genetic Hybrids,	25/9/19	09/10/19	PPT, black board and

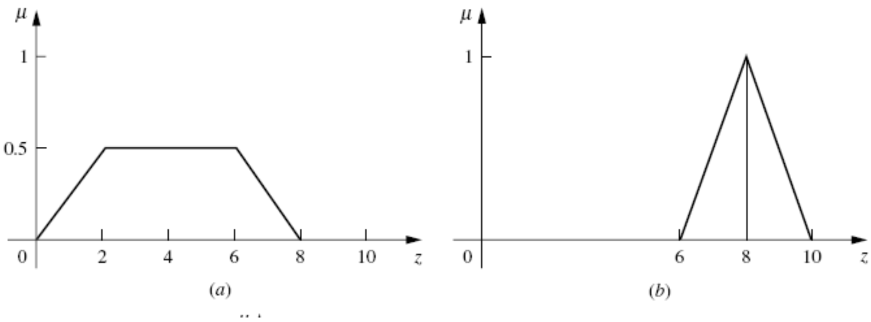
	Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems Genetic Fuzzy Rule based Systems, Advantages of Genetic Fuzzy Hybrids			chalk

Assignment Plan:

Assignment No	**Date**	**Questions**	**CO**
1	20/8/19	On chapter 1,2,3	1,3,5
2	17/9/19	On chapter 4,5,6	1,3,6

Sample Questions of assignment are :

<table>
<tr><td>Sr.No.</td><td>Questions</td></tr>
<tr><td>1</td><td>1. What is the need of fuzzy set theory?
2. What are different ways of representing fuzzy set.
3. Determine all possible strong α level sets of Ã={0.3/1+0.4/2+0.8/3+0.5/4+0.3/6}
4. Let universe of discourse X=Y=[1,2]. Let fuzzy relation P defined on X and Y as
$$P = \begin{bmatrix} 0.1 & 0.5 \\ 0.3 & 0.2 \end{bmatrix}$$
Determine whether the system is stable, oscillating or unstable</td></tr>
<tr><td>2</td><td>1. Who introduced fuzzy set theory?
2. Explain projection and cylindrical extension on fuzzy relation with example.
3. Define the energy of fuzzy relation and state how it is useful to decide whether system is stable, unstable or oscillatory
4. Give the universe of discourse for the following :
Age of a person, Weight of a person, No of rooms in a flat, No of vehicles a family possess. How many of these are continuous?</td></tr>
<tr><td>3</td><td>1. Give Difference between classical set and fuzzy set.
2. Let Ã={0.4/3+1/5+0.6/7} B={1/5+0.6/6} Find AXB, CON(A), DIL(A)
3. Write properties of fuzzy set and fuzzy relation
4. Let Ã={1/S_1+0.5/S_2+0.2/S_3} B={1/W_1+0.5/W_2+0.2/W_3}Find fuzzy relation R=ÃxB. Let fuzzy set C={0.1/S_1+0.6/S_2+1/S_3}Find fuzzy relation S =C X B. Find R º S using max-min composition and max-product composition</td></tr>
</table>

4	1. Model cold, warm and hot temp using fuzzy sets. 2. Let Ã={0.4/3+1/5+0.6/7} B={1/5+0.6/6} Find A+B(algebraic sum), AΘB(bounded difference) , A bounded sum B 3. Explain types of fuzzy relation 4. Let Ã={0.9/X_1+0.4/X_2+0.0/X_3} B={0.1/Y_1+0.7/Y_2+1/Y_3}Find fuzzy relation R=ÃxB. Let fuzzy set C={0.3/X_1+1/X_2+0.2/X_3}Find R º C using max-min composition and max-product composition
5	1. Model the following as fuzzy set using trapezoidal membership function- “Number close to 10” 2. Write true/false. Correct false statement meaningfully a. The support of a fuzzy set is a crisp set b. Demorgan’s theorem do not apply to to fuzzy sets c. A membership function for a classical set can not be defined d. The values of membership in a given set can never add up to one e. The CON operation always reduces the value of membership f. AXB=BXA g. Continuous membership functions have to be of triangular shape 3. Consider the output of fuzzy controller is the union of following two fuzzy sets. Apply any three defuzzification method.  4. Develop graphical representation of membership function to describe linguistic variables young, middle aged and old. The age ranges from 0 to 100. Also show plot for “young and middle aged” and “middle aged or old” age.
6	1. Model the following as fuzzy set using trapezoidal membership function- “middle aged person” 2. Let A={(1,0.2),(2,0.5),(3,0.8),(4,1),(5,0.7),(6,0.3)}. Then find all possible α level sets. Consider universe of discourse X={1,2,3,4,5,6,7,8}, find cardinality and relative

	cardinality of set Ã 3. Consider a case of train approaching or leaving the station. The inputs are distance from the station and speed of train. The output is the amount of brakes power used. Write the rule base for this example. 4. Explain convex fuzzy set and non convex fuzzy set with diagram
7	1. Model using triangular membership function fuzzy set " number considerable larger than 11" 2. What all operations can be performed on fuzzy relations? Write the properties of fuzzy relation 3. Develop graphically membership functions to describe the linguistic variables "cold","warm", and "hot". The temp. range is 0^oc to 100^oc. Use the graphs developed to define graphically the following : a. NOT warm b. Warm OR cold c. warm AND hot 4. Explain fuzzy extension principle with example
8	1. Define support, core, normality, height, nucleus, width and crossover points for fuzzy set. 2. Let X={1,2,3,4,5,6,7,8,9,10}, A={(4,0.1),(6,0.2),(8,0.4),(10,0.5)}, B={(0,0.3),(2,0.5),(4,0.7),(5,0.8),(8,0.7)} find AUB, A∩B, A|B 3. Give the difference between soft computing and hard computing 4. Determine all α-level sets and all strong a-level sets for the following fuzzy set. A = { (2,1), (4,0.2), (5,0.3), (6,0.4), (7,0.6), (8, 0.8), (10,1), (12, 0.8), (l4,0.6)} For α = 0.3, 0.5, 0.8
9	1. Given Ã={1/2+0.5/3+0.3/4+0.2/5} B={0.5/2+0.7/3+0.2/4+0.4/5} Find Complement Ã, Complement B, Ã UB, Ã ∩ B, Ã |B, B| Ã, Verify Demorgan's law 2. Write a short note on Defuzzification techniques. 3. Define empty fuzzy set and Universal fuzzy set 4. Consider a set P={p1, P2, P3, P4} of four varieties of paddy plants set D={D1,D2,D3,D4} of the various diseases affecting the plants and S={S1 S2 S3 S4} be common symptoms of the diseases. Let R be a relation on P*D and S be

the relation on D*S. Find RoS given

R= 0.6 0.6 0.9 0.8 S = 0.1 0.2 0.7 0.9

0.1 0.2 0.9 0.8 1 1 0.4 0.6

0.9 0.3 0.4 0.8 0 0 0.5 0.9

0.9 0.8 0.1 0.2 0.9 1 0.8 0.2

Obtain the association of the plants with the different symptoms of the diseases using max-min composition

10

1. Compare two sensors based upon their detection levels and gain settings. Given universe of discourse X={0,20,40,60.80,100} and sensor detection levels S1 and S2 to be S1={0/0+0.5/2+0.65/40+0.85/60+1/80+1/100}
S2={0/0+0.45/20+0.6/40+0.8/60+0.95/80+1/100}

Find out the following S1US2, S1∩S2, (Complement(S1)) U S2, (Complement (S1)) ∩ S2

What are standard membership functions.

2. There is a relation R is a subset of A X B. Find the projection along axis A and projection along axis B.

$$M_R = \begin{array}{c|ccc} {}_{A}\diagdown^{B} & b_1 & b_2 & b_3 \\ \hline a_1 & 0.1 & 0.2 & 1.0 \\ a_2 & 0.6 & 0.8 & 0.0 \\ a_3 & 0.0 & 1.0 & 0.3 \end{array}$$

3. Explain fuzzy controller with a block diagram

4. High speed rail monitoring devices sometimes make use of sensitive sensors to measure the deflection of the earth when a rail car passes. These deflections are measured with respect to some distance from the rail car and, hence are actually very small angles measured in rnicroradians. Let a universe of deflection be A = [I, 2, 3, 4] where A is the angle in microradians, and let a universe of distances be D = [), 2, 5, 7J where D is distance in feet, suppose a relation between these two parameters has been determined as follows:

R =

	D_1	D_2	D_3	D_4
A_1	1	0.3	0.1	0
A_2	0.2	1	0.3	0.1
A_3	0	0.7	1	0.2
A_4	0	0.1	0.4	1

Now let a universe of rail car weights be W=[1,2], where W is the weight in units of 100,000 pounds. Suppose the fuzzy relation of W to A is given by

S =

	W_1	W_2
A_1	1	0.4
A_2	0.5	1
A_3	0.3	0.1
A_4	0	0

Using the two relations, find the relation $R^T{}_0S = T$

Using Max-min composition and Using Max-product composition

11

1. What are fuzzy relations?
2. Let R be a relation from A to B defines by matrix

	b1	b2	b3
a1	0.4	0.5	0
a2	02	0.8	0.2

Let S be a relation from B to C defined by matrix

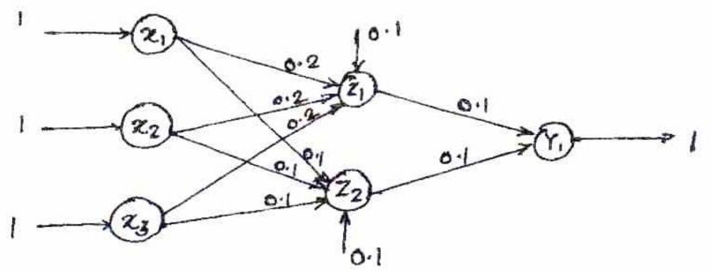
	c1	c2
B1	0.2	0.7
B2	0.3	0.8
B3	1	0

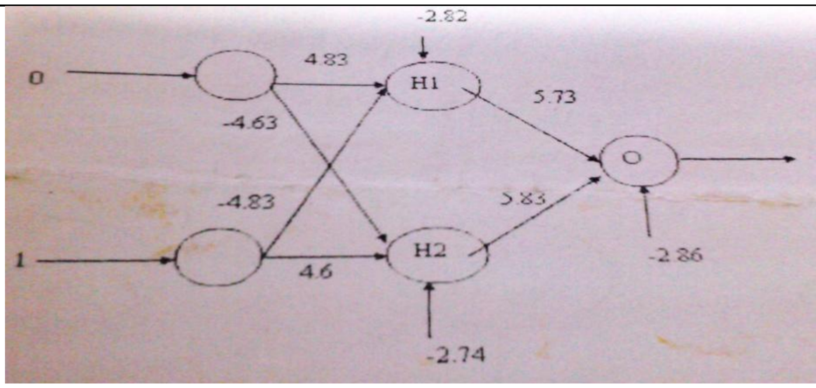
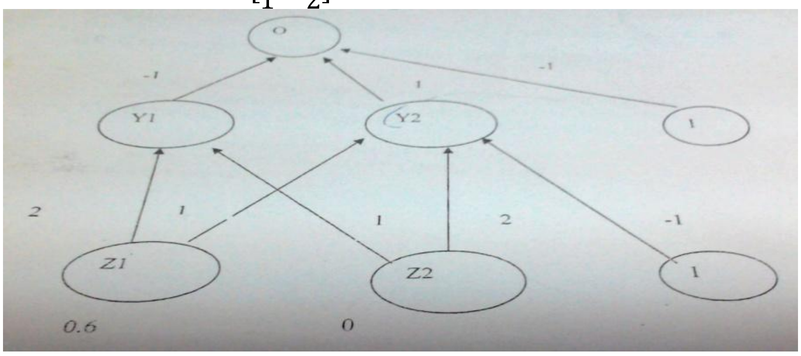
Find a) Max-min composition of R and S b)Max-Product composition of R and S

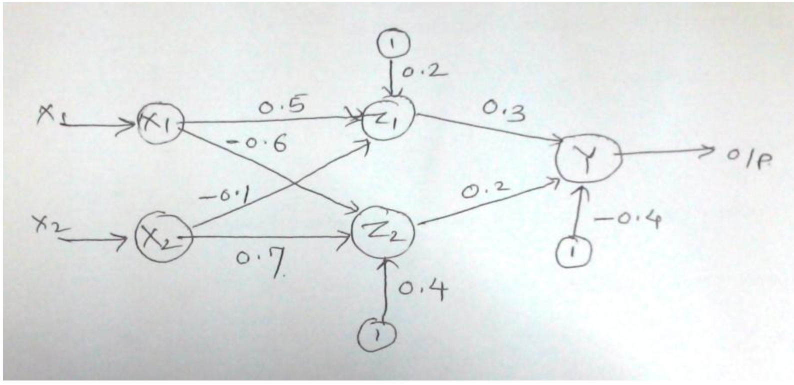
3. Let universe of discourse X=Y=[1,2]. Let fuzzy relation P defined on X and Y as

$$P = \begin{bmatrix} 0.1 & 0.3 \\ 0.7 & 1 \end{bmatrix}$$

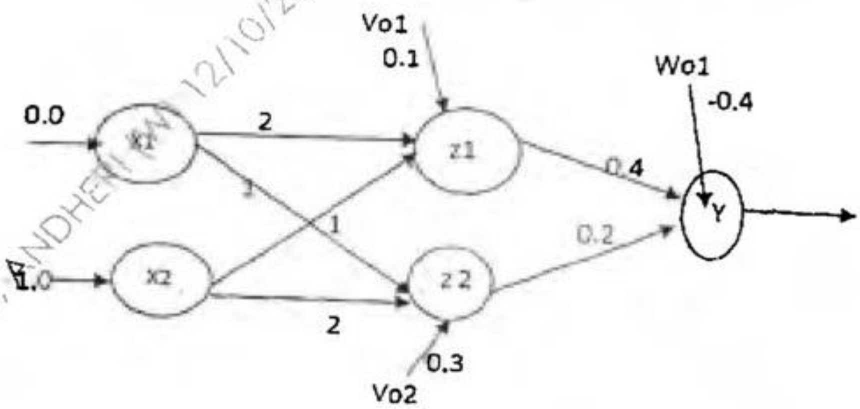
	Determine whether the system is stable, oscillating or unstable

Sr.No.	Questions
1	1. Explain McCulloch and Pitts model of Neuron with example. 2. Describe the basic Hopfield model and give the theory of energy minimization in auto associative Hopfield model 3. Explain outstar learning rule and widro Hoff learning rule 4. Explain the single discrete perceptron training algorithm (SDPTA)
2	1. Explain common activation functions used in neural network 2. Determine the weights after one iteration for Hebbian learning of a single neuron network starting with initial weights w=[1 -1 0 0.5], inputs as x1=[1 -2 1.5 0], x2=[1 -0.5 -2 -1.5], x3=[0 1 -1 1.5], c=1. Use bipolar binary activation function. 3. What is competitive learning? Explain Winner-take all learning. 4. Explain the models of artificial neural network
3	1. (b) For the given network  Find new weights when net is presented the input pattern (1, 1, 1) and target output is '1'. Use learning rate of 0·1 and bipolar sigmoidal activation function, the bias is set to '1'. Activation function : $f(x) = \frac{2}{1+e^{-x}} - 1$ and $f'(x) = 0{\cdot}5\ (1 + f(x))\ (1 - f(x))$ 2. Given two input neuron with following parameters: b=1.2, w=[3 2] and p=[-5 6] . Calculate neuron output for the following transfer function : hard limit, symmetrical hard limit, linear, saturating linear and log sigmoid 3. Consider a simple Hopfield network made up of 3 neurons. Assume the bias applied to each neuron is zero. For the attractor states (1 -1 1) and (-1 1 -1). Find the weight matrix 4. Using the perceptron learning rule, find the weights required to perform the following classification. Vectors (I 1 1 1), (-1 1 -1 -1) and (1 -1 -1 1) are members of class (having target value 1) and vectors (1 1 1 .7 1) and (1 -1 -1 1) are not members of class(having target value -1). Use learning rate of 1 and starting weights zero.
4	1. What is learning in neural networks? Differentiate between Supervised and Unsupervised learning 2. Compute the output of the following network using unipolar continuous activation function.

	 3. Calculate upto three cycles the final weights for the perceptron learning rule. The input patterns with desired output is given below X1=[1 -2 0 -1] d1=1 X2=[0 1.5 -0.5 -1] d2=-1 X3=[-1 1 0.5 -1] d3=1 Initial weight vector w=[1 -1 0 0.5] and c=0.1 4. Using Hebb rule of discrete BAM, find the weight matrix to store the following input-output pattern pairs :s 1 = (1, 1, 0,) t1 (1, 0) s2 = (0, 1, 0,) t2 (0, 1)
5	1. Explain EBPTA with flowchart. 2. Calculate the output of following network using unipolar continuous function and new weights using EBPTA W=[-1 1], W0= -1, V=$\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$, V0=[0 -1] , t=0.9, η =0.3  3. Four steps of Hebbian learning of a single-neuron network have been implemented starting with **w1** = [**1** - 1] ' for learning constant **c** = 1 using inputs as follows: x1=[1 -2], x2=[0 1] x3=[2 3] x4=[1 -1] Find final weights for: (a) bipolar binary ***f (net)*** (b) bipolar continuous f ***(net),*** $\boldsymbol{\lambda}$ = ***1 .*** 4. Discuss the factors affecting the learning of neural network
6	1. Explain linearly separable and linearly non-separable patterns with example. 2. Explain the architecture of Bidirectional associative memory. How is storage and retrieval performed in BAM 3. A single neuron network using f(net) = sgn(nct) has been trained using the pairs of (X_j,d_i)as given below :XI = [1 -2 3 -1] d_I = -1 X_2 = [0 -1 2 -1] d_2 = 1 X_3 = [-2 0 -3 -1], d_3 =-1 The final weights obtained using the perceptron rule are W_4 = [3 2 6 1] Knowing that correction has been performed in each step for c=l, determine the following weights : (a) W_3,W_2,W_I by backtracking the training.(b) W5,W6,W7(obtained for

	steps 4,5,6 of training by reusing the sequence (Xt. d_t), (X_2, d_2), (X_3, d_3)) 4. Explain generalized delta learning rule
7	1. Write a short note on Gradient descent method 2. Design XOR problem using RBF network with given data set as (1,1), (0,1), (0,0),(1,0) and also find the weight vector 3. Determine the weights after one iteration for Hebbian learning of a single neuron network starting with intial weights w=[1 -1 0 0.5] inputs as x1=[1 -2 1.5 0] x2=[1 -0.5 -2 -1.5] x3=[0 1 -1 1.5] and c=1. Use signum activation function 4. What are the two processes involved in RBF network design?
8	1. What is learning in neural networks? Compare different learning rules 2. Find new weights after one iteration using back propagation for the network shown in figure. The network is presented with input pattern [1 0] desired output is 1. Use α=0.3 and bipolar continuous activation function  3. A neuron with 4 inputs has the weight vector w = [1 2 3 4]. The activation function is linear, that is, the activation function is given by f(net) = 2 *net. If the input vector is X == [5 6 7 8], then find the output of the neuron. 4. A two layer network is to have four inputs and six outputs. The range of the outputs is to be continuous between 0 and 1. What can you tall about the network architecture? Specifically, (a) How many neurons are required in each layer? (b) What are the dimensions of the first-layer and second layer weight matrices? (Hidden layer neurons are 5) (c) What kinds of transfer functions can be used in each layer?
9	1. Consider the following orthonormal sets of key pattern applied to a correlation matrix memory . x1=[1 0 0 0]^t, y1=[5 1 0]^t, x2=[0 1 0 0]^t, y2=[-2 1 6]^t, x3=[0 0 1 0]^t, y3=[-2 4 3]^t Calculate memory matrix M and show that memory associates perfectly. 2. Explain perceptron learning rule convergence theorem. Design a perceptron network to implement an AND function, take first input sample [1, 1, 1]

Apply Backpropogation Algorithm to find the final weights for the following net.
Inputs: x = [0.0,1.0], Weights between Hidden and Output Layers : w = [0.4 ,0.2] ,Bias on the Output Node O is Wo= [-0.4], Weights between Input and Hidden Layer: v = [2,1 ;1,2], Bias on Hidden Unit nodes are Vo= [0.1 0.3], Desired output : d = 1.0 ,



3. A neuron with 3 inputs has the weight vector w = [0.1 0.3 – 0.2]. The activation function is binary sigmoidal activation function. If input vector is [0.8 0.6 0.4] then find the output of neuron.

4. Consider a 4 input, 1 output parity detector. The output is 1 if the number of inputs is even. Otherwise, it is 0. Is this problem linearly separable? Justify your answer.