FACULTY OF ELECTRICAL & ELECTRONICS ENGINEERING

TEST 2

COURSE	**:**	**INTELLIGENT CONTROL**
COURSE CODE	**:**	**BEE4333**
LECTURER	**:**	**HASZURAIDAH ISHAK**
DATE	**:**	**29 MAY 2014**
DURATION	**:**	**2 HOURS**
SESSION/SEMESTER	**:**	**SESSION 2012/2013 SEMESTER II**
PROGRAM	**:**	**BEE**

NAME: _____

STUDENT ID: _____

NRIC: _____

INSTRUCTIONS TO CANDIDATES

1. This question paper consists of **TWO (2)** questions. Answer **ALL** questions.
2. All the calculations and assumptions must be clearly stated.
3. Write your answers in the exam booklet provided.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

This examination paper consists of **SIX (6)** printed pages including front page

QUESTION 1

(a) Describe **THREE (3)** differences between fuzzy logic and neural network.

[6 Marks]

(b) Consider the following 3x3 LED system. This system is trained to recognize **THREE (3)** different characters, **H**, **I** and **T**. The illustration of the system and the pattern for recognizing the characters is shown in Figure 1.

Design a multilayer neural network with **ONE (1)** neuron in **ONE (1)** hidden layer for training purpose of the system. Say that the initial value of all weights used in the system is **0.1**. The desired output that is related to the output pattern **H**, **I** and **T** are 0.1, 1 and 10, respectively.

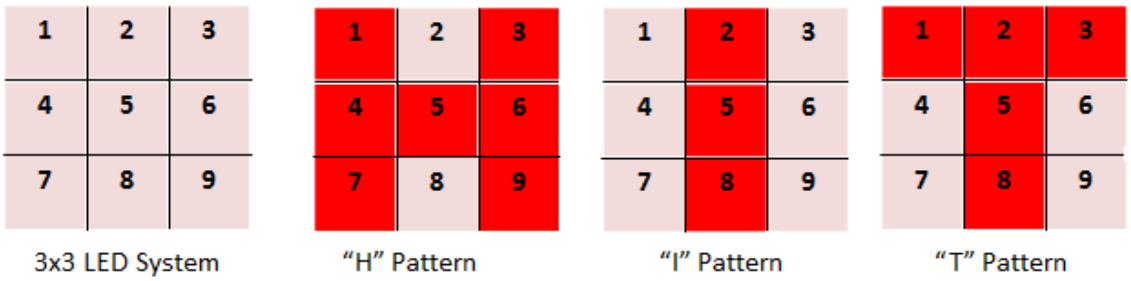

Figure 1. 3x3 LED System and Pattern of "H", "I" and "T"

(i) Illustrate the neural network.

[2 Marks]

(ii) Calculate the actual output for the given weights and pattern of character **H** if we apply a sigmoid function as the hard limiter of the system.

Note : sigmoid function → $f(x) = \frac{1}{1+e^{-x}}$

[2 Marks]

(iii) Given t_k=0. From the value of (i), calculate the following values at the first iteration by using Back Propagation algorithm.

- Δw_{11} and w_{11} (new) between output and hidden layer
- Δw_{11}, Δw_{12}, Δw_{13}, *and* w_{11}*(new),* w_{12}*(new),* w_{13}*(new)* between hidden layer and input layer.
- Illustrate the new Neural Network.

The information for the Neural Networks configurations is as follows.

- The input is symbolized as x_i
- The output of hidden layer is symbolized as y_j
- The output of hidden layer is symbolized as y_k
- The learning rate is α = 0.1.
- Error gradient in output layer : $\Delta w_{jk}(p) = \alpha \times y_j(p) \times \delta_k(p)$
- $\delta_k(p) = y_k(p) \times [1 - y_k] \times e_k(p) \quad where \quad y_k = \frac{1}{1+\exp(-x_k(p))}$

  $e_k(p) = y_{d,k}(p) - y_k(p)$

  Update $w_{jk}(p+1) = w_{jk}(p) + \Delta w_{jk}(p)$
- Error gradient in hidden layer $\Delta w_{ij}(p) = \alpha \times x_i(p) \times \delta_j(p)$
- $\delta_j(p) = y_j(p) \times \left[1 - y_j\right] \times \sum_{k=1}^{l} \delta_k(p) \times w_{jk}(p)$

  Update $w_{ij}(p+1) = w_{ij}(p) + \Delta w_{ij}(p)$

[15 Marks]

[CO1, PO1]

QUESTION 2

(a) The application of an Artificial Neural Network (ANN) involves two phases, which are *Learning phase* and *Recall phase*. In the *Learning phase* (usually offline) the ANN *is trained until it has learned its tasks* (through the adaptation of its weights). Explain about the types of *learning phase* in ANN and give **TWO (2)** the characteristic of each type.

[6 Marks]

(b) Figure 3 illustrates a multilayer Neural Network that has the input patterns of (0 1 1).

(i) Calculate the output value of L_k.

(ii) Given t_k=0. From the value of L_k, calculate the following values at the first iteration by using Back Propagation algorithm.

- Δw_{11} and w_{11} (new) between output and hidden layer
- Δw_{11}, Δw_{12}, Δw_{13}, *and* w_{11}*(new),* w_{12}*(new),* w_{13}*(new)* between hidden layer and input layer.
- Illustrate the new Neural Network.

The information for the Neural Networks configurations is as follows.

Given $\eta = 0.1$ and $\alpha = 0.1$.

Back propagation is not required to be derived.

Sigmoid function*;* $f(x) = (1+e^{-x})^{-1}$

$f(x) = x$

The error signals are as follows.

$$\delta_k = L_k (1- L_k)(t_k - L_k)$$

$$\delta_j = Lj (1- L_j) \sum_k \delta_k w_{kj}$$

Adaptions of weights are defined as below.

$$\Delta w_{kj}(t + 1) = \eta \delta_k L_j + \alpha \Delta w_{kj}(t)$$

$$\Delta w_{ji}(t + 1) = \eta \delta_j L_i + \alpha \Delta w_{ji}(t)$$

[19 Marks]
[CO2, PO3, C4]

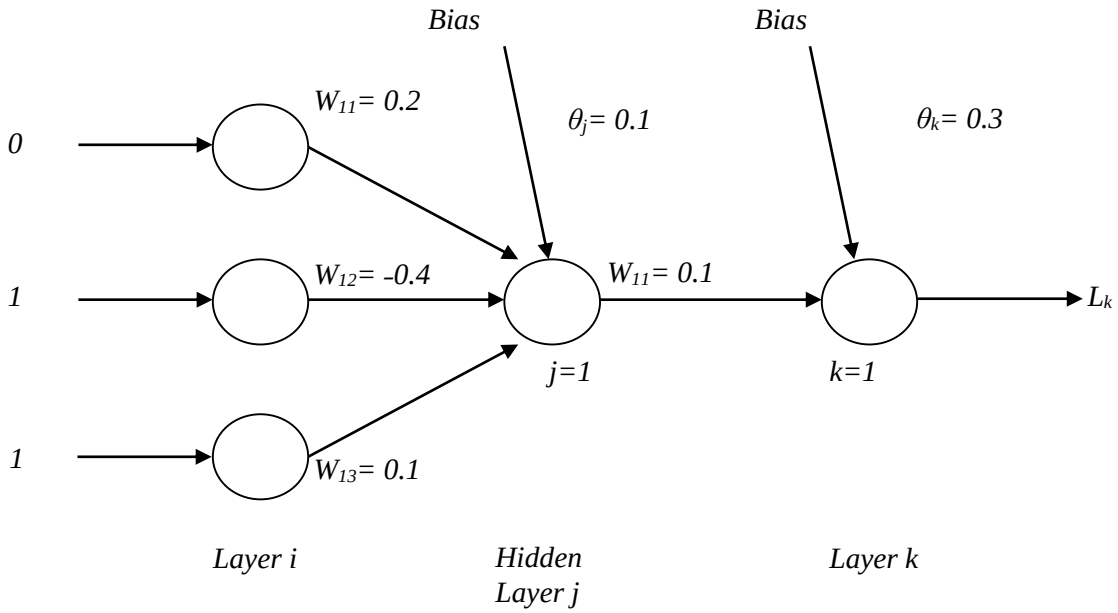

Figure 3: A Multilayer Neural Network

END OF QUESTION PAPER