Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – III • EXAMINATION – WINTER 2012

Subject code: 730702 Date: 26/12/2012

Subject Name: Application of Artificial Intelligence to Power Systems

Time: 10.30 am – 01.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)(i)** Match the following. **03**

(1) Chromosome (string, individual)	(a)	Position of gene
(2) Genes (bits)	(b)	Encoded solution
(3) Locus	(c)	Decoded solution
(4) Alleles	(d)	Solution (coding)
(5) Phenotype	(e)	Part of solution
(6) Genotype	(f)	Values of genes

(ii) What is roulette –wheel selection? **04**

(b)(i) Backtracking forms part of which basic activity of AI? Describe dependency-directed backtracking, and its alternatives. **03**

(ii) Explain the difference between an 'algorithm' and a 'heuristic'. **03**

(iii) Give a definition of artificial intelligence **01**

Q.2 **(a)** Describe three approaches / techniques using ANNs with which we can overcome the 'curse of high dimensionality' of operating space for static security assessment **07**

(b) Elaborate on the four important features associated with artificial neural networks **07**

OR

(b) Give the equations for neuron outputs in the hidden and output layers of Elman's backpropagation neural network, along with equations that enable updation of weight coefficients during its training. **07**

Q.3 **(a)** Give the block diagram of an Intelligent System for electricity demand forecasting and explain the same. **07**

(b) Give the brief history and basic principles of any two intelligent systems **07**

OR

Q.3 **(a)** Describe how to solve a power transmission network maintenance scheduling problem using a hybrid GA and a greedy optimizer. **07**

(b) Compare the behavior and attributes of intelligent systems with conventional computer programs. Enumerate four important properties that intelligent systems possess. **07**

Q.4 **(a)** Describe the advantages of combining expert systems with non-linear optimization functions for voltage control **07**

(b) Decode the Prufer number P = {4 4 4 5}. Give an algorithm to convert a Prufer sequence into a tree. **07**

OR

Q.4 **(a)** What advantages would artificial neural networks offer to a hybrid expert system approach to voltage collapse monitoring. **07**

Q.4 **(b)** A horizontal force acts on the bottom end of the lower bar of a two bar pendulum used to control a valve in a power plant. The unknown parameters are the two angles subtended by each bar with respect to the vertical. If the minimum and maximum angles subtended by each bar are 0° and 90° respectively, find the accuracy of a 4 bit binary string encoding for each unknown. Give the binary encoding, decoded value and the angles in a table to be used by a Genetic Algorithm. **07**

Q.5 **(a)** Apply the fuzzy modus ponens rule to deduce that velocity is very low given the following: **07**

(a) If the pressure is medium then the velocity is low.

(b) The pressure is high.

Let H (High), M (Medium), L (Low) and VL (Very Low) indicate the associated fuzzy sets as follows:

For the set of pressures P = {30, 40, 50, 60, 70, 80, 90, 100} and the set of velocities Y = {10, 20, 30, 40, 50, 60},

VL = {(10, 1), (20, 0.8)}

L = {(30, 0.8), (40, 1), (50, 0.6)}

M = {(70, 1), (80, 1), (90, 0.3)}

H = {(90, 0.9), (100, 1)}

(b) A neuron receives inputs from four other neurons whose activity levels are 10, -20, 4 and -2. The respective synaptic weights of the neurons are 0.8, 0.2, -1.0, and -0.9. Calculate the output of neuron j for the following situations: **07**

(a) The neuron is linear

(b) The neuron is represented by the McCulloch-Pitts model. Note that the McCullock-Pitts model is defined as follows:

$Y_k = 1$ if $V_k \geq 0$

$Y_k = 0$ if $V_k < 0$

where $V_k = \sum(W_{kj} X_j + B_k), j = 1,2, \ldots, m.$

OR

Q.5 **(a)** Solve the following fuzzy relation equation, where ° indicates the max-min composition **07**

$$A \circ \begin{bmatrix} 0.9 & 0.6 & 1 \\ 0.8 & 0.8 & 0.5 \\ 0.6 & 0.4 & 0.6 \end{bmatrix} = [0.6 \quad 0.6 \quad 0.5]$$

(b) Consider the function **07**

$f(x) = x \sin(10\pi x) + 1.0$

The domain of the problem is $x \in [-1, 3]$

Which number would a chromosome $(10001011101101010000111)$ represent if $x' = (10001011101101010000111)_2 = 2,288,967$ and if $2^{20} = 1,048,576$

****