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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST -3 EXAMINATION- MAY 2019
B. Tech 8th Semester

COURSE CODE: 18B1WEC837 **MAX. MARKS: 35**
COURSE NAME: THEORY AND APPLICATION OF INTELLIGENT SYSTEMS
COURSE CREDITS: 3 **MAX. TIME: 2 Hrs.**

Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.

1. Derive the back-propagation algorithm for a mult-layer neural network. **[4 marks]**

2. Explain the architecture of recurrent neural network and learning of RNN using back-propagation through time. **[6 marks]**

3. Define deep neural network and explain how they are different from shallow networks. Write-down the steps to train the DNN, algorithm proposed by Hinton, Le-Cun and Bengio. **[4 marks]**

4. Define radial basis function network. Explain the Online learning rule to train RBFN. **[3 marks]**

5. Consider the trajectory tracking problem of a single-link manipulator. The dynamic equation of the manipulator model is given as

$$ml^2\ddot{\theta}+k\dot{\theta}+mgl\cos\theta=\tau$$

Find a control law so that θ tracks a desired trajectory θ_d. Check the stability of the given system for the Lyapunov function $V=\frac{1}{2}ml^2\dot{e}^2+\frac{1}{2}k_pe^2$ where e is the error and k_p is the proposrtional gain. **[5 marks]**

6. Consider the nonlinear system given by state equations

$$\dot{x}_1=-x_1+x_2+x_1(x_1^2+x_2^2)$$
$$\dot{x}_2=-x_1-x_2+x_2(x_1^2+x_2^2)$$

Check the stability of the origin (0, 0) of the above nonlinera system and show that this the equilibrium of the system. Also, find the region of attraction. **[5 marks]**

7. Consider two fuzzy relations

$R=\begin{bmatrix}0.6 & 0.8\\ 0.7 & 0.9\end{bmatrix}$ *and* $S=\begin{bmatrix}0.3 & 0.1\\ 0.2 & 0.8\end{bmatrix}$, evaluate *RoS and SoR* using max-min composition and max-product rule. **[4 marks]**

8. Explain the block-diagram of a fuzzy control system. Give any two examples of fuzzy IF-THEN rule with suitable linguistic variables. **[4 marks]**