ARTIFICIAL NEURAL NETWORK

**Course Objective:**  
To introduce the concept of artificial network as an alternative options for solving engineering problems.

1. **Working with data (4 hours)**
   1. Data types; data, information and knowledge; concept of data mining; Dimension reduction of data matrix: Principal component analysis.

1. **Introducton of Artifical Neural Network (ANN) (6 hours)**
   1. Biological Analogy, Historical development; ANN terminology; network structure; basis functions; activation functions; advantages of ANN; application areas of ANN.

1. **Learning process & optimization techniques (10 hours)**
   1. supervised learning: Error correction learning, memory based learning
   2. unsupervised learning: Hebian learning, competitive learning
   3. learning with critic
   4. gradient descent and least mean square
   5. Derivative free optimization techniques: advantages of derivative free techniques; genetic algorithm: fundamental of GA and biological background.; GA operators & GA operation.
   6. Simulated annealing: theoretical background and algorithm.

1. **Supervised network (8 hours)**
   1. McCullotch and Pitt Neuron; LTUs, simple perceptron and perceptorn learning. Limitation of simple percepron.
   2. ADDALINE network and delta rule
   3. Multilayer perceptron: Needs of multilayer network, generalized delta rule (error‐backpropagation), effect of momentum term and learning rate
   4. Error backpropagation learning of sigmoidal units; drawbacks of error‐backpropagation

1. **Unsupervised network (4 hours)**
   1. competitive network: network structure & working;
   2. dissimilarity measures;
   3. Self Organizing Map and Kohonen learning;
   4. applications

1. **Special networks (4 hours)**
   1. Radial basis function network: structure and working procedure, advantages
   2. LVQ network: structure and learning approach
   3. Hopefield network
   4. Autoassociative memory network: general structure and Purpose, Autocorrelator; Heterocorrelator

1. **Application of ANN in Electrical Engineering (8 hours)**
   1. Fault diagnosis
   2. Control application
   3. Network planning
   4. Forecasting task.
   5. State estimation
   6. Unit commitment

**Practical:**

1. Computer simulation of PCA.
2. Computer simulation of perceptron network
3. computer simulation of back propagation network
4. A Shortterm case study demonstrating ANN application for a specific purpose.

**References:**

1. Simon Hykin, "Neural networks A Comprehensive Foundation", second edition; Pearson Education.