"Students governed by the old ordinances will be examined out of 75 marks and their obtained marks shall be proportionately raised".

Note: Attempt ALL questions. Make suitable assumptions, if required.

Q. 1 (a) Give the diagram of a biological neuron and its mathematical model along with the various activation functions that are commonly used. What is the significance of synapse in the process of learning? 8

Q. 1 (b) Explain the working of a Linear machine for minimum distance classification. 7

OR

Q. 1' (a) Implement the following logic functions of 4 inputs with minimum number of neurons. 
   \( F_1 = \Sigma(1,4,5,6,12), \quad F_2 = \Sigma(0,1,3,4,5,6,9,12), \quad F_3 = \Sigma(3,5,15), \quad F_4 = \Sigma(0,1,5,8) \) 8

Q. 1' (b) What is a linearly separable function? How many neurons are required to implement a linearly separable function of 50 inputs? Implement a Majority function of 25 inputs. 7

Q. 2 (a) Design a binary classifier if the three binary input vectors [000], [001], and [110] lie in Class A and the remaining five are in Class B. 5

Q. 2 (b) A cube of side 2 units is centred at (1,0,2). Design a neural network such that all pattern vectors lying inside the cube produce an output 1 and those outside give -1. Specify the activation function used. 10

Q.3(a) What are Feedback neural networks? Give one example along with its architecture. Discuss their stability issues. 5

Q.3 (b) Give the implementation of a Hopfield network with N neurons having self feedback and external inputs along with regular cross feedback. Derive its Energy function. Where do the stable states lie? 10

OR

Q. 3' (b) Modify a Hopfield network implementation of two neurons, by interchanging the input terminals of the operational amplifier. Derive its Energy function and explain how the minima are modified. 10

Q. 4 (a) Design a RBFN for strict interpolation of the given input-output examples \( \{x_i,d_i\}, i=1,2,3 \). 10

<table>
<thead>
<tr>
<th>( x_i )</th>
<th>0</th>
<th>1</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( d_i )</td>
<td>2</td>
<td>-1</td>
<td>0</td>
</tr>
</tbody>
</table>

Q. 4 (b) What is Cover’s theorem? Apply it to implement the XOR function with less than three neurons. 5