

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP/2025)

CLASS: BTECH
BRANCH: AI/ML

SEMESTER : VI
SESSION : SP/2025

SUBJECT: AI305 DEEP LEARNING

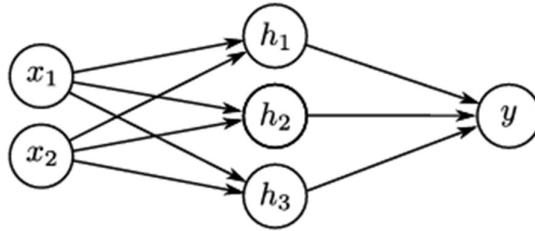
TIME: 02 Hours

FULL MARKS: 25

INSTRUCTIONS:

1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

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|---|-----|---------|-----------|
| Q.1(a) What is shallow network?. Determine the equations for y and the hidden units h_1 , h_2 , and h_3 given the graph below. Make your own assumptions about the weights and bias parameters on hidden units and output unit.(Use 'RELU' function). | [2] | CO 1 | BL III |
|---|-----|---------|-----------|



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| Q.1(b) Find the parameters (ϕ_0, ϕ_1) for the given loss function which minimizes the loss function: $L[\phi] = \sum_{i=1}^N (y_i - (\phi_0 + \phi_1 x_i))^2$ | [3] | 3 | III |
| Q.2(a) State and explain the Universal Approximation Theorem. | [2] | 1 | I |
| Q.2(b) Explain and design (with equations and network) a shallow network with multivariate inputs and outputs.(Assume own parameters ,1-input and two outputs and 3-hidden units.) | [3] | 2 | III |
| Q.3(a) Explain and illustrate the difference between shallow and deep neural network. | [2] | | I |
| Q.3(b) Consider a deep neural network with a single input, a single output, and K hidden layers, each of which contains D hidden units. Show that this network will have a total of $3D + 1 + (K-1)D(D+1)$ parameters. | [3] | | II |
| Q.4(a) Explain the hyperparameters in the Deep neural network. Consider a deep neural network with $D_i = 5$ inputs, $D_o = 1$ output, and $K = 20$ hidden layers containing $D = 30$ hidden units each. What is the depth of this network? What is the width | [2] | | I |
| Q.4(b) Derive the loss function for univariate regression problem. | [3] | | V |
| Q.5(a) For a deep network of 4 inputs, 2 layers of 10 and 8 hidden units, and 3 outputs, what are the sizes of each weight matrix Ω and bias vector B ? | [2] | | I |
| Q.5(b) Derive a loss function for binary classification. | [3] | | V |