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

CLASS: BTECH **SEMESTER : IV**
BRANCH: FOOD TECHNOLOGY **SESSION : SP/2025**

SUBJECT: FE223 STATISTICAL MACHINE 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**

			CO	BL
Q.1	A robot is being trained to classify objects as 'Edible' or 'Not Edible' based on four attributes: Color, Shape, Texture, and Size. The following training examples are given: Training Examples: Red, Round, Smooth, Small → Edible Green, Oval, Rough, Large → Not Edible Yellow, Round, Smooth, Large → Edible Red, Oval, Rough, Small → Not Edible Red, Round, Rough, Large → Edible a) Apply the Find-S algorithm to find the most specific hypothesis. b) Apply the Candidate Elimination Algorithm to determine the version space. c) Predict whether the object (Red, Round, Smooth, Large) is Edible or Not Edible.	[5]	CO1	BL3
Q.2(a)	A learning algorithm is given three attributes, each with three possible values: 1. Color = {Red, Blue, Green} 2. Shape = {Round, Square, Triangle} 3. Size = {Small, Medium, Large} A hypothesis can either specify a value or use "?" (wildcard). Question: Find the total number of semantically distinct hypotheses.	[3]	CO1	BL3
Q.2(b)	What are the key limitations of the Find-S algorithm in concept learning? Provide a brief explanation.	[2]	CO1	BL1
Q.3	Why is a standard regression model not well-suited for classification tasks? Identify two key limitations and explain how logistic regression overcomes them. Derive the cost function for logistic regression with its mathematical formulation.	[5]	CO2	BL2
Q.4(a)	Show that the logistic sigmoid function satisfies the property $\sigma(-a) = 1 - \sigma(a)$ and that its inverse is given by $\sigma^{-1}(y) = \ln\{y/(1-y)\}$	[3]	CO2	BL3
Q.4(b)	What is an unbiased learner in machine learning? Define and explain its significance in the learning process.	[2]	CO1	BL1
Q.5(a)	A linear regression model with hypothesis $h(x) = w_0 + w_1x$ is trained using gradient descent. Given initial weights $w_0 = 2$, $w_1 = 1$, learning rate $\alpha = 0.1$, and the following data points: x (Input) | y (Output) 2 | 5 4 | 10 6 | 15 Update the weights for 3 iterations using the Mean Squared Error (MSE) loss function and Compute w_0 and w_1 after each iteration.	[5]	CO2	BL3

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