BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

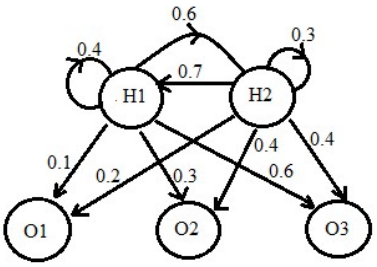
CLASS: BTECH **SEMESTER : V**
BRANCH: AI **SESSION : MO/2025**

SUBJECT: AI203 MATHEMATICS FOR DATA SCIENCE

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Define Laplacian Matrix of a graph. Show that Laplacian Matrix is semi-positive definite.	[5]	1	1
Q.1(b)	Explain Fiedler value and vector of a graph. Explain its importance in graph partition.	[5]	1	1
Q.2(a)	Show that transition matrix of Markov chain has eigen value "1".	[5]	2	2
Q.2(b)		[5]	2	4



Initial State

$$\begin{bmatrix} H1 \\ H2 \end{bmatrix} = \begin{bmatrix} 0.15 \\ 0.85 \end{bmatrix}$$

H means "Hidden state" and O "means Observed state" .

Using the figure above find the probability $P\left(\frac{H1}{O1}\right)$.
For the sequence of observed states O1, O2, O3 find the probability that sequence of hidden states is H1, H2, H2.

Q.3(a)	Explain the concept of "Linear Discriminant Analysis" in data analysis.	[5]	3	4
Q.3(b)	Say $A = U\Sigma V^T$ (S.V.D) and $A = \begin{bmatrix} 1 & 0 & -1 \\ 0 & 1 & 0 \end{bmatrix}$. Find *U*.	[5]	3	4
Q.4(a)	Find the best fit line passing through (1,3), (2,4), (3,8), (4,9) using least square error.	[5]	4	4
Q.4(b)	Find the Newton divided interpolating polynomial through (1,0), (2,5), (3,22), (4,57).	[5]	4	3
Q.5(a)	Fit the linear function y = ax + b through coordinates (1,1), (2, 4), (3,5) using Gradient decent method with initial approximation of a = 2.0 and b = -1 . (run only two iterations)	[5]	5	4
Q.5(b)	Explain the mathematical concept behind "Maximum Likelihood estimation".	[5]	5	2

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