

Q1. The construction of a critical infrastructure project, such as a long-span bridge, involves complex engineering considerations. Develop a rule-based **fuzzy expert system** for Structural Health Monitoring (SHM) and decision support, considering the following parameters: deflection, strain, and vibration.

Define the rules based on the given scenarios:

Deflection (mm) with tolerance of 1mm:

- Low: Below 5 mm; Moderate: 5 to 15 mm; High: Above 15 mm

Strain (%) with tolerance of 10%:

- Low: Below 0.1%; Moderate: 0.1% to 0.5%; High: Above 0.5%

Vibration (Hz):

- Low: Below 2 Hz; Moderate: 2 to 5 Hz; High: Above 5 Hz

Utilize the fuzzy rule-based system to address the structural health of the bridge. Assume three alert levels: Green (No action required: negative/ positive small), Yellow (Monitor closely negative / positive medium), and Red (Immediate intervention required negative/ positive large). Develop a goal-driven inference process to determine the appropriate alert level based on the input parameters.

Consider the following input conditions:

- Deflection: 10 mm; Strain: 0.3%; Vibration: 3 Hz

Show the goal-driven inference process and determine the alert level.

(40)

Q.2 The objectives of the soil exploration and classification are to find the suitability of the soil for the construction of different structures, embankments, sub-grades and wearing surfaces. The input and output variables are given below:

Input				Output (IS classification)
Colour	(Gravel %)	(Sand %)	(Liquid limit %)	Type
0.1	0.1	0.54	0.58	0.3
0.3	0	0.33	0.71	0.2

Train the network with the given data and infer to find the classification for colour = 0.1, gravel 0, sand 0.65, fine grained particles 0.70, liquid limit 0.65, and plastic limit 0.50. **Use sigmoid function for hidden layer and Tanh for output layer.** (a) Use BPN (4-2-1), (b) Complete 1 epoch only

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Q.3. A person has to collect the samples of water from wells A, B, C, D, and E. He will come back to the same point from where he has started (i.e. if he starts from A, he will go to B, C, D, E, and come back to A). The distances among them are given in table. Find the shortest cumulative distance. (use the random table: Take last two digits of your id no. Last digit indicates the starting row no and the other digit indicates the starting column no.)

	A	B	C	D	E
A		38	21	29	33
C	21	38		49	48
D	29	9	49		39
E	33	45	48	39	

Take

1. Population size = 5
2. Cross-over probability = 0.6,
3. Mutation probability = 0.05
4. Iteration (initial + 2) = 3

USE proper cross over operator and representation of chromosome.

(25)