K. K. Wagh Institute of Engineering Education & Research, Nashik

(An Autonomous Institute From A.Y. 2022-23)

WINTER-2025	
Exam Seat No.:	
Academic Year:2025-2026	Semester:VI
Class:TY	Program:B.Tech
Branch Code:ROB	Pattern:2022
Name of Course:Swarm Intelligence for Robotics	Course Code:ROB223015(C)
Max. Marks:60	Duration:2.30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains04page(s).
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

Marks CO

Question No. 1

1a) What is multimodality? Why the gradient based methods are unable to handle multimodality? (6) CO1

Question No. 2

2a) A fuzzy logic is used to dynamically update inertia weight (w). Determine the input parameters (i) Improvement in global best and (ii) deviation in fitness values (to be minimized) shown below: (6) CO2, CO5

S.N.	1	2	3	4	5	6
Initial fitness value	20	26	25	48	52	18
Updated fitness value	33	21	16	32	44	24

Question No. 3

3a) Explain the application of ant colony optimization algorithm for motion planning of articulated robot. (8) CO1, CO3

OR

3b) Ant colony optimization is used to solve a travelling salesmen problem with 4 stations. The distance matrix is given in Table 1. Considering starting station A and for a random number of 0.38, which path will be selected by the ant? Current pheromone levels are shown in Table 2. (8) CO1, CO3

Table 1: The distance matrix

	A	B	C	D

A	0	3	14	5
B	3	0	5	4
C	14	5	0	11
D	5	4	11	0

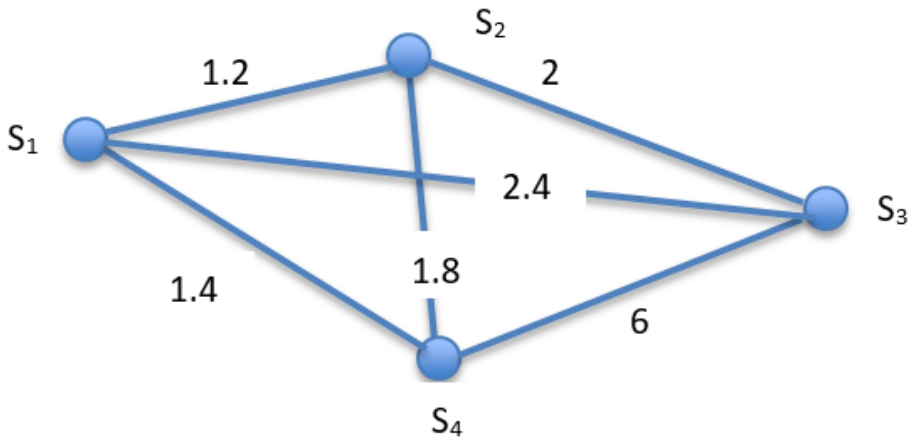
Table 2: Current pheromone levels

	1	2	3	4
1	0.5	0.5	0.5	0.5526
2	0.5192	0.5	0.5167	0.5
3	0.5334	0.5	0.5	0.5
4	0.5	0.5167	0.5192	0.5

3c) What are algorithm specific parameters for ant colony optimization. How they are tuned? (8) CO2

OR

3d) An Autonomous Mobile Robot (AMR) is used to transfer material between four stations S_1, S_2, S_3, and S_4. The distances between the stations are shown in Fig. An ant colony optimization algorithm is used to determine the shortest path visiting each station exactly once. The start and end station is S_1. What is the probability that ant will select path $S_1 \rightarrow S_4$ if initial pheromone level is 0.4? (8) CO1, CO3



Question No. 4

4a) A planer two link robot having both revolute joints (θ_1 and θ_2). The link lengths are 5 cm and 7 cm respectively. For artificial bee colony algorithm, the initial 6 solutions are as shown in Table. Determine the onlooker bees (out of 20) assigned to each solution if the targeted position robot end effector is (9.60, 7.15). (8) CO1, CO3

S.N.	1	2	3	4	5	6
θ_1	32	45	22	51	62	20
θ_2	25	18	36	87	27	44

OR

4b) Explain the working of artificial bee colony algorithm. State its applications in the field of robotics. (8) CO1, CO3

4c) In an artificial bee colony algorithm, the objective function to minimize is $f = x.y.z - 2x^2$. such that $1 \leq x \leq 8$, $3 \leq y \leq 10$, and $5 \leq z \leq 15$. The initial food source positions are shown below. What will be the updated food source positions if opposition based learning is used. (8) CO1, CO5

food source	x	y	z
1	4	8	10
2	1	6	5
3	4	4	12
4	5	8	10
5	2	5	9

OR

4d) Explain application of artificial bee colony algorithm to improve the transient response of the controller. (8) CO1, CO3, CO4

Question No. 5

5a) What is job shop scheduling? How the swarm intelligence algorithms can be used for job shop scheduling? (8) CO1, CO3

OR

5b) Explain the application concept of swarm robotics. How ant colony optimization method is implemented in swarm robotics? (8) CO1, CO3

5c) A robot is used to sort five objects based on their color in two groups. The RGB values for the objects captured by vision system are as shown below. Use *K*- Means clustering to perform this task. (8) CO3

Object No.	Red (R)	Green (G)	Blue (B)
1	55	68	74
2	12	155	26

3	44	201	196
4	172	18	63
5	42	178	218

OR

5d) Explain application of ant colony optimization to Tool path planning in hole making operations (8) CO1, CO3

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