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

CLASS: BTECH   SEMESTER : VI
BRANCH: CSE   SESSION : SP/2024

SUBJECT: CS351 NATURE INSPIRED COMPUTING
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)	What are the features of Meta-Heuristic algorithms? How Meta-Heuristic algorithms are different from Evolutionary Algorithms? [5]	1	2
Q.1(b)	Classify different types of Evolutionary Algorithms with their applicability, advantages and drawbacks in a tabular form. [5]	1	3
Q.2(a)	State two scenarios where you like to apply Roulette wheel and Rank based selection. Justify your answer with proper arguments with the steps involved. [5]	2	5
Q.2(b)	"The main purpose of using elitism in evolutionary algorithms is to keep the reference for promising areas of the search space across the generations". Justify the statement with different types of elitism schemes. [5]	5	5
Q.3(a)	To stop the flow of Program using Genetic Algorithm, what criterions may you follow? State the conditions of each criterion. [5]	4	2

Q.3(b) Consider a problem of maximizing the following function: [5]   3   5
$f(x)=x^2+2x+1$
where x is permitted to vary between 0 and 20. Use Genetic Algorithm to solve this problem for one iteration showing each operators applied. Take six population as initial sample. Analyze the observation.

Q.4(a) Assume 4 cities {A, B, C, D}, which are represented by a fully connected graph   [5]   4   4
(undirected). The following tables represent the pheromone levels on each edge of
the graph and the distances between each city (assume the pheromone levels and
distances are symmetric).

Pheromone Levels				
	A	B	C	D
A				
B	0.25			
C	0.11	0.98		
D	0.34	0.54	0.67	

Distances				
	A	B	C	D
A				
B	12			
C	10	6		
D	8	15	3	

i)   Assume an ant started its journey at city A and has travelled to city C. Using the transition rule formulae find out: What is the probability that the ant will travel to city A?

ii)   Assume the ant completes its tour using the route ACBD. What will be the pheromone levels on each edge once they have been updated? Assume Q = 100 and the evaporation parameter is set to 0.5.

Q.4(b) Use PSO to solve the following problem: [5]   4   4
Maximize $f(x,y) = x^{0.5} - 1/y$; $0 \leq (x,y) \leq 5$

Q.5(a) The bat moves toward optimal solution according to following two design equations. [5] 4 4

$$A_i^{t+1} = \alpha A_i^t \qquad \text{------------------------------------(i)}$$
$$r_i^{t+1} = r_i^0 \left[1 - \exp\left(-\gamma t\right)\right] \qquad \text{------------------------------------(ii)}$$

How the above equations are related to their movement once a bat has found prey?

Q.5(b) The working principle of the ABC algorithm is as follows: [5] 2 2

Initialization Phase

REPEAT
  Employed Bees Phase
  Onlooker Bees Phase
  Scout Bees Phase
  Memorize the best solution achieved so far
UNTIL(terminating condition)

Explain Employed, Onlooker and Scout Bees Phase with supporting equations.

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