			Marks	BL	PO	CO	PSO
OR	iii.	Explain the following: (a) The three-phase of Artificial Bee Colony (ABC) Optimization. (b) Double Bridge experiment.	6	2	05	02	01
Q.5	i.	Compare Particle Swarm Optimization (PSO) and Genetic Algorithm (GA), pointing out the pros and cons of each.	4	2	05	01	01
	ii.	Maximize $f(x) = x^2 + 1$ using PSO? For given population (a) Use W=0.7, c1=0.20, c2=0.60, n=5 (five particle) (b) Perform for two iterations. (c) r1=[0.4657,.8956,.3877,.4902,.5039] r2=[.5319,.8185,.8331,.7677,.1708]	6	3	05	03	01
OR	iii.	Discuss the following- (a) Accelerated PSO (b) Multimodal PSO (c) Operations of PSO	6	2	05	01	01
Q6.		Attempt any two:					
	i.	Discuss the processes of social foraging shown by E. coli bacteria.	5	2	05	01	01
	ii.	In what ways can chemotactic behavior affect foraging efficiency and group movement?	5	2	05	02	01
	iii.	What are the main distinctions between the conventional BFO algorithm and its variants?	5	2	05	02	01

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Total No. of Questions: 6   Total No. of Printed Pages:4

Enrollment No......................................

Faculty of Engineering
End Sem Examination Dec 2024
EC3ET06 Metaheuristic Techniques

Programme: B.Tech.   Branch/Specialisation: EC

Duration: 3 Hrs.   **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

			Marks	BL	PO	CO	PSO
Q.1	i.	Let $f_1(X)$ and $f_2(X)$ represent two objective functions; formulate a new overall objective function for optimization as follows- (a) $f(X) = \alpha_1 f_1(X) - \alpha_2 f_2(X)$ (b) $f(X) = \alpha_1 f_1(X) + \alpha_2 f_2(X)$ (c) $f(X) = \alpha_1 f_1(X) / \alpha_2 f_2(X)$ (d) $f(X) = \alpha_1 f_1(X) * \alpha_2 f_2(X)$	1	1	05	01	01
	ii.	The No Free Lunch Theorems state- (a) All algorithms provide almost identical responses to the specified problem (b) All methods have significance since they may provide varied responses to various problems (c) A limited number of algorithms dominate (d) A unique algorithm must be developed for every distinct problem	1	1	05	01	01
	iii.	Genetic algorithms are influenced by- (a) Waggle dance (b) Darwin's Theory of Evolution (c) Einstein's Theory of Evolution (d) The "No Free Lunch" Theorems	1	1	05	01	01
	iv.	Allel is- (a) Value gene taken for particular chromosome (b) All the Values taken for particular chromosome (c) Population in computational space (d) One of the given problem value	1	1	05	01	01

P.T.O.

v. Which of the following is not a fundamental feature of Swarm Intelligence? **1**   1   01   01
(a) Autocatalytic in nature
(b) Positive feedback
(c) Pheromone
(d) Parallelism

vi. Ant Colony Optimization is motivated by- **1**   1   05   01   01
(a) The pheromone trail-laying behavior of artificial ant colonies
(b) The analogous behavior of ant colonies optimization
(c) The nature of the issue
(d) The pheromone trail-laying behavior of actual ant colonies

vii. Which of these parameters serves as both an initial and a control parameter? **1**   1   05   01   01
(a) Iteration count   (b) Swarm size
(c) Particle velocity   (d) Inertia weight

viii. In PSO, the focus in on a group of- **1**   1   05   01   01
(a) Ant (b) Bee   (c) Bird   (d) Bacteria

ix. Which of the following is a variation of the Bacterial Foraging Optimization (BFO) algorithm? **1**   1   05   01   01
(a) Genetic BFO   (b) Fuzzy BFO
(c) Simulated BFO   (d) Particle BFO

x. What is the primary mechanism through which E. coli bacteria exhibit social foraging? **1**   1   05   01   01
(a) Random movement
(b) Chemotaxis
(c) Phototaxis
(d) Reproductive strategies

Q.2 i. Define the term "Optimization" and provide an example for explain objective function, design variable and equality constrain. **4**   2   05   01   01

ii. Please elaborate on the concepts of exploration and exploitation in the context of metaheuristics with example. **6**   2   05   01   01

OR iii. Find out the crowding distance and Pareto-Optimal solution of given multi objective problem in which item with min weight and max value is required. **6**   3   05   02   01

| Item	A	B	C	D	E	F
Weight	5	5	7	8	8	10
Value (Rs)	100	50	100	100	150	20

Q.3 i. Perform the selection, mutation and crossover to the following chromosome? **3**   2   05   02   01
(a) Uniform Crossover   (b) Rank Selection
(c) Flipping

Chromosome 1	100101011110
Chromosome 2	010101101011

ii. Maximize $x^2 + 1$ using Genetic Algorithm? For given population and use signal crossover for two iteration. **7**   3   05   03   01
(a) 01101   (b) 01000
(c) 11000   (d) 10010

OR iii. Describe each- **7**   2   05   02   01
(a) Types of selection
(b) Octal encoding and value encoding
(c) Steps of genetic algorithm

Q.4 i. What do you mean by honey bee algorithm? Explain its essential characteristic. **4**   2   05   01   01

ii. In an ant colony system with four cities, the kth ant is at city 1. What is the probability that the kth ant will go to each of the other cities in the following situations? **6**   3   03   01
(a) No evaporation is present and α=1 and β=2
(b) Evaporation is present ρ=0.4 and α=2 and β=2

C=4 and P=5
C=2 and P=4
C=6 and P=1
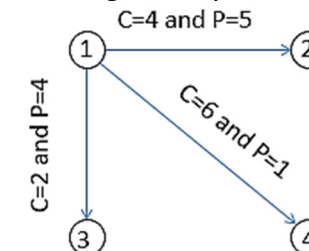
Q.1   i.   Answer: b) $f(X) = \alpha_1 f_1(X) + \alpha_2 f_2(X)$ 1

ii. Answer: b) All methods have significance since they may provide varied responses to various problems.   1

iii Answer: b) Darwin's Theory of Evolution   1

iv. Answer: a) Value gene taken for particular chromosome   1

v.   Answer: c) Pheromone   1

vi. Answer: d) The pheromone trail-laying behavior of actual ant colonies.   1

vii. Answer: b) Swarm size   1

viii Answer: c) Bird   1

ix. Answer: b) Fuzzy BFO   1

x.   Answer: b) Chemotaxis   1

Q.2   i.   Define the term "optimization" and provide an example 1M for explain objective function, design variable and equality constrain. 3M   4

ii   Please elaborate on the concepts of exploration 3M exploitation in the context of metaheuristics with example. 3M   6

OR   iii Find out the crowding distance **3M** Pareto-Optimal solution of given multi objective problem in which item with min weight and max value is required **3M**   6

Item	Weight	Value
A	5	100rs
B	5	50rs
C	7	100rs
D	8	100rs
E	8	150rs
F	10	20rs

Q.3   i   Perform the selection, mutation and crossover to the following chromosome? 3M   6
1.Uniform Crossover 1M
2. Rank Selection 1M
3.Flipping 1M

Chromosome 1	100101011110
Chromosome 2	010101101011

ii   Maximize $x^2 +1$ using Genetic Algorithm? **4M**   7
For given population and use signal crossover for two iteration. **3M**

1.01101
2.01000
3.11000
4.10010

OR   iii Describe each :   7
1. Types of Selection **2M**
2. Octal Encoding and Value Encoding **2M**
3. Steps of Genetic Algorithm **3M**

Q.4   i   What do you mean by swarm intelligence **2M**   4
Explain its essential characteristic. **2M**

ii   In an ant colony system with four cities, the kth ant is at city 1. What is the probability that the kth ant will go to each of the other cities in the following situations?   6
a. No evaporation is present and $\alpha=1$ and $\beta=2$ **3M**
b. Evaporation is present $\rho=0.4$ and $\alpha=2$ and $\beta=2$ **3M**
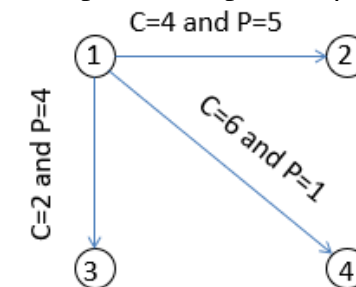
OR   iii Explain the following: 6
a. The three-phase of Artificial Bee Colony (ABC) Optimization. **3M**
b. Double Bridge experiment. **3M**

Q.5   i   Compare Particle Swarm Optimization (PSO) and Genetic   **4**
             Algorithm (GA) pointing out the pros **2M** cons of each.**2M**

       ii   Maximize $f(x) = x^2 + 1$ using PSO? For given population   **6**
             1. Use W=0.7, c1=0.20, c2=0.60, n=5 (five particle)
             2. Perform for two iterations.
             3. r1=[0.4657,.8956,.3877,.4902,.5039]
                r2=[.5319,.8185,.8331,.7677,.1708] **3+3**

OR   iii   Discuss the following: **6**
             a) Accelerated PSO **2M**
             b) Multimodal PSO **2M**
             c) Operations of PSO **2M**

Q6.   i   Discuss the processes of social foraging shown by E. coli   **5**
             bacteria.

OR   ii   In what ways can chemotactic behavior affect foraging   **5**
             efficiency and group movement?

       iii   What are the main distinctions between the conventional BFO   **5**
             algorithm and its variants?

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