ii. Explain the following with diagram and example: **5**
 (a) How Honey Bee gives the information about the food source distant and direction to other honey bees.
 (b) Real ant searches their food and communicates with each other and updates the path.

iii. Discuss the following: **5**
 (a) Differences between Real and artificial ants
 (b) Virtual Ant Algorithm and its fundamental difference from Other Bee Algorithms

Q.5 Attempt any two:

i. Explain the operation of Particle Swarm Optimization of the basis of following points: **5**
 (a) Write the name Initial and control parameters used in PSO
 (b) Write steps used in implementing PSO
 (c) Formula used to updating velocity of particle
 (d) Formula used to change in position of particle

ii. Compare GA and PSO and mention applications of Particle Swarm optimization **5**

iii. Maximize $f(x) = 1+2x-x^2$ using PSO? For given population **5**
 (a) Use W=0.7, c_1=0.20, c_2=0.60, n=5 (five particle)
 (b) Perform for two iterations.
 (c) r_1=[0.4657,.8956,.3877,.4902,.5039]
   r_2=[.5319,.8185,.8331,.7677,.1708]

Q.6 Attempt any two:

i. Explain Forging theory and foraging behavior of E. Coli bacteria? **5**
ii. Discuss the following terms: **5**
 (a) Chemotatic   (b) Swarming
 (c) Reproduction   (d) Elimination and dispersal
iii. Compare BFO algorithm with other variations of BFO. **5**

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

Faculty of Engineering
End Sem (Odd) Examination Dec-2019
EC3ET06 / EI3ET06 Metaheuristic Techniques
Programme: B.Tech.   Branch/Specialisation: EC/EI

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.

Q.1 i. The classification based on the nature of the design variables cannot be classified into broad category: **1**
 (a) Parameter optimization problems
 (b) Dynamic optimization problems
 (c) Trajectory optimization problems
 (d) Stochastic optimization problems

ii. A mathematical programming problem involving a number of stages, where each stage evolves from the preceding stage in a prescribed manner known as: **1**
 (a) Optimal problems   (b) Optimal control problems
 (c) Constrain problems   (d) All of these

iii. If crossover probability is 0% then **1**
 (a) Whole new generation is made from exact copies of chromosomes from old population
 (b) Whole new generation is made from different copies of chromosomes from old population
 (c) All offspring are made by crossover reflected
 (d) Changes made after but in few are old

iv. In given set of population which chromosome has highest fitness value **1**

$r1$	2	4	7	4	8	5	5	2
$r2$	3	2	5	4	3	2	1	3
$r3$	3	2	7	5	2	4	1	1
$r4$	2	4	4	1	5	1	2	4

 (a) r1   (b) r2   (c) r3   (d) r4

P.T.O.

v. Which of these are not Inherent features of Ant Colony Optimization? **1**
(a) Parallelism   (b) Stochastic nature
(c) Adaptive   (d) Use of negative feedback

vi. In Artificial Bee Colony (ABC) optimization algorithm forager bees are **1**
known as
(a) Onlooker bees   (b) Scouts
(c) Employed bees   (d) Observer bees

vii. In PSO inertia weight (α or W) value is large then **1**
(a) Greater local search can be done
(b) Greater global search can be done
(c) Both local search and global search stops
(d) Both local search and global search done equally

viii. If acceleration coefficients c_1 < acceleration coefficients c_2 then **1**
(a) Greater local search can be done
(b) Greater global search can be done
(c) Both local search and global search stops
(d) Both local search and global search done equally

ix. Foraging theory is based on **1**
(a) Maximizes their energy intake E per unit time T spent foraging
(b) Maximizes their Time spent foraging intake energy E
(c) Minimize their time T spent foraging intake energy E
(d) Minimize their energy intake E per unit time T spent foraging

x. Ambush searchers is **1**
(a) The forager moves continuously through the environment, constantly searching for prey at the boundary of the volume being searched
(b) The forager remains stationary and waits for prey to cross into its strike range
(c) The forager moves continuously through the environment, constantly searching for prey at outside volume being searched
(d) The forager remains stationary and waits for prey to strike itself

Q.2   Attempt any two:

i. Define Optimization and Explain following terms with at least one **5**
example
(a) Objective function   (b) Decision variable and Design vector
(c) Design Constrain   (d) Type of Variables.

ii. (a) Find the maximum and minimum values of $2x^3-24x+107$ on the **5**
interval [-3, 3].
(b) State No Free Lunch Theorems and mention its limitation.

iii. (a) A Farmer has 4000ft of facing and wants to create a rectangular field **5**
along a river. He needs no fence along the river. What is the largest
area of the rectangular field?
(b) Explain the following terms:
    I. Metaheuristics Exploitation and Exploration
    II. Multi objective optimization (give example)

Q.3 i. Explain the following with example: **4**
(a) Parent Selection in Genetic Algorithm
(b) Types of Encoding used in GA

ii. Use Genetic Algorithm to minimize a function, $F(x) = x^2 + y^2$ where $1 \leq$ **6**
$x \leq 15$ and $y \geq 3$ with $x + y = 7$
(a) Use one point crossover only
(b) Perform minimization for two iterations.

OR iii. Maximize x^2-1 over (0 to 31) using GA? For given population **6**
   I. 01100   II. 11001   III. 00101   IV. 10011
(a) Use two point crossover only
(b) Use flipping mutation only
(c) Perform maximization for two iterations.

Q.4   Attempt any two:

i. Given an Ant–Colony system with four cities and the kth ant is at city 1 **5**
what is the probability of the kth ant proceeding to each of the cities with
following cases:
(a) No evaporation is present and $\alpha=2$ and $\beta=3$.
(b) Evaporation is present $\rho=0.4$ and $\alpha=2$ and $\beta=3$
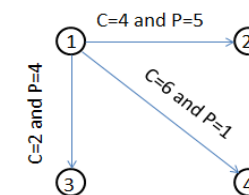
Where C=cost /distance, P= Pheromone level

Marking Scheme
EC3ET06 / EI3ET06 Metaheuristic Techniques

Q.1 i. The classification based on the nature of the design variables cannot be classified into broad category: **1**
(d) Stochastic optimization problems

ii. A mathematical programming problem involving a number of stages, where each stage evolves from the preceding stage in a prescribed manner known as: **1**
(b) Optimal control problems

iii. If crossover probability is 0% then **1**
(a) Whole new generation is made from exact copies of chromosomes from old population

iv. In given set of population which chromosome has highest fitness value **1**
(a) r1

v. Which of these are not Inherent features of Ant Colony Optimization? **1**
(d) Use of negative feedback

vi. In Artificial Bee Colony (ABC) optimization algorithm forager bees are known as **1**
(c) Employed bees

vii. In PSO inertia weight (α or W) value is large then **1**
(b) Greater global search can be done

viii. If acceleration coefficients c_1 < acceleration coefficients c_2 then **1**
(a) Greater local search can be done

ix. Foraging theory is based on **1**
(a) Maximizes their energy intake E per unit time T spent foraging

x. Ambush searchers is **1**
(b) The forager remains stationary and waits for prey to cross into its strike range

Q.2 Attempt any two:
i. Definition of Optimization 1 mark **5**
(a) Objective function 1 mark
(b) Decision variable and Design vector 1 mark
(c) Design Constrain 1 mark
(d) Type of Variables 1 mark

ii. (a) Maximum and minimum values 3 marks **5**
(b) State No Free Lunch Theorems 1 mark
Its limitation 1 mark

iii. (a) Largest area of the rectangular field 3 marks **5**
(b) Explain the following terms:
I. Metaheuristics Exploitation and Exploration 1 mark
II. Multi objective optimization 1 mark

Q.3 i. Explain the following with example: **4**
(a) Parent Selection in Genetic Algorithm 2 marks
(b) Types of Encoding used in GA 2 marks

ii. Use Genetic Algorithm to minimize a function **6**
3 marks for each iteration (3 marks * 2)

OR iii. Maximize x^2-1 over (0 to 31) using GA? For given population **6**
3 marks for each iteration (3 marks * 2)

Q.4 Attempt any two:
i. Given an Ant–Colony system with four cities: **5**
(a) No evaporation is present and α=2 and β=3. 2 marks
(b) Evaporation is present ρ=0.4 and α=2 and β=3 3 marks

ii. Explain the following with diagram and example: **5**
(a) How Honey Bee gives the information about the food source distant and direction to other honey bees. 2.5 marks
(b) Real ant searches their food and communicates with each other and updates the path. 2.5 marks

iii. Discuss the following: **5**
(a) Differences between Real and artificial ants 2.5 marks
(b) Virtual Ant Algorithm and its fundamental difference from Other Bee Algorithms 2.5 marks

Q.5 Attempt any two:
i. Explain the operation of Particle Swarm Optimization of the basis of following points: **5**
(a) Name Initial and control parameters 1 mark
(b) Steps used in implementing PSO 2 marks
(c) Formula used to updating velocity of particle 1 mark
(d) Formula used to change in position of particle 1 mark

ii. Compare GA and PSO 4 marks **5**
Applications of Particle Swarm optimization 1 mark

iii. Maximize f(x) = 1+2x-x^2 using PSO **5**
2.5 marks for each iteration (2.5 marks * 2)

Q.6   Attempt any two:

    i.   Forging theory   2 marks   **5**

               Foraging behavior of E. Coli bacteria   3 marks

    ii.   Discuss the following terms: **5**

               1.25 marks for each   (1.25 marks *4)

    iii.   Compare BFO algorithm with other variations of BFO.   **5**

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