Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2022

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.

Q.1 i. Which of the following is not an example of continuous variable? **1**

(a) Size
(b) Speed of car
(c) Number of holes in electrical Socket
(d) Weight

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 control problems (b) Optimal problems
(c) Constrain problems (d) All of these

iii. Which of the following is not an operator in genetic algorithm? **1**

(a) Mutation (b) Chromosome (c) Crossover (d) Selection

iv. In GA, Population in the actual real-world solution space is known as- **1**

(a) Genotype (b) Decoding (c) Encoding (d) Phenotype

v. The artificial bee colony (ABC) optimization algorithm is divided into the bees in a colony. **1**

(a) Two parts (b) Four parts (c) Three parts (d) None of these

vi. Employed bee of a discarded food site is forced to become- **1**

(a) Onlooker bees (b) Employed bees again
(c) Scout (d) Observer bees

vii. PSO technique based on- **1**

(a) Intelligence (b) Artificial intelligence
(c) Swarm intelligence (d) Swam size

P.T.O.

viii. p-best value is- **1**
(a) The best solution (fitness) particle itself has achieved so far
(b) The best solution (fitness) another particle has achieved so far
(c) The best solution (fitness) all particles has achieved so far
(d) None of these

ix. The adaptive bacterial foraging optimization ABFO used to overcome- **1**
(a) A poor convergence behaviour problem in BFO
(b) A good convergence behaviour problem in BFO
(c) Both (a) & (b)
(d) None of these

x. 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

Q.2 i. Explain any two classification of optimization problem with example? **2**

ii. Compare metaheuristic techniques with heuristic techniques. **3**

iii. (a) Find the maximum and minimum values of $2x^3-24x+107$ on the interval [-3, 3]. **5**
(b) State no free lunch theorems and mention its limitation

OR iv. An open-top box is to be made from a by piece of cardboard by removing a square from each corner of the box and folding up the flaps on each side. What size square should be cut out of each corner to get a box with the maximum volume. **5**
For above problem write objective function and constrain equation only.

Q.3 i. Write applications of optimization techniques? **2**

ii. Maximize x^2-1 over (0 to 31) using GA? For given population- **8**

1.01100
2.11001
3.00101
4.10011

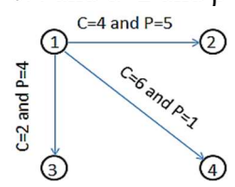
(a) Use two-point crossover only
(b) Use flipping mutation only
(c) Perform maximization for two iterations.

OR iii. What is the selection operation in genetic algorithm? Explain its type with example? **8**

Q.4 i. Explain the characteristics of ant colony optimization? **3**

ii. Explain each step of the Artificial Bee Colony (ABC) optimization in detail with an example? **7**

OR iii. Given an ant–colony system with four cities and the k^{th} ant is at city 1 what is the probability of the k^{th} ant proceeding to each of the cities with following cases- **7**
(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

Q.5 i. Define PSO and compare PSO with GA. Also mentioning it advantage and limitations. **4**

ii. Maximize $f(x) = 1+2x-x^2$ using PSO? For given population- **6**
(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]

OR iii. Explain the operation of particle swarm optimization each step including the formulas. **6**

Q.6 Attempt any two:

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

ii. Describe forging theory and foraging behaviour of E. Coli bacteria. **5**

iii. What do you mean by reproduction, elimination and dispersal? **5**

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Marking Scheme
EC3ET06 Metaheuristic Techniques

Q.1	i.	Which of the following is not an example of continuous variable? (c) Number of holes in electrical Socket		**1**
	ii.	A mathematical programming problem involving a number of stages, where each stage evolves from the preceding stage in a prescribed manner known as- (d) All of these		**1**
	iii.	Which of the following is not an operator in genetic algorithm? (b) Chromosome		**1**
	iv.	In GA, Population in the actual real-world solution space is known as- (d) Phenotype		**1**
	v.	The artificial bee colony (ABC) optimization algorithm is divided into the bees in a colony. (c) Three parts		**1**
	vi.	Employed bee of a discarded food site is forced to become- (c) Scout		**1**
	vii.	PSO technique based on- (c) Swarm intelligence		**1**
	viii.	p-best value is- (a) The best solution (fitness) particle itself has achieved so far		**1**
	ix.	The adaptive bacterial foraging optimization ABFO used to overcome- (a) A poor convergence behaviour problem in BFO		**1**
	x.	Foraging theory is based on- (a) Maximizes their energy intake E per unit time T spent foraging		**1**
Q.2	i.	Any two classification of optimization problem (1 mark each)		**2**
	ii.	Any three metaheuristic techniques with heuristic techniques (1 mark each)		**3**
	iii.	(a) maximum and minimum values (b) State no free lunch theorems its limitation	(3 marks) (1 mark) (1 mark)	**5**
OR	iv.	Objective function Constrain equation	(2 marks) (3 marks)	**5**
Q.3	i.	Any two applications of optimization techniques	(1 mark each)	**2**
	ii.	(a) Use two-point crossover only (b) Use flipping mutation only (c) Perform maximization for two iterations	(2 mark) (2 mark) (2 marks each)	**8**
OR	ii.	Definition Any three types with example	(2 mark) (2 marks each)	**8**
Q.4	i.	Any six characteristics of ant colony optimization	(0.5 mark each)	**3**
	ii.	As per Explanation		**7**
OR	iii.	(a) No evaporation is present and $\alpha=2$ and $\beta=3$. (b) Evaporation is present $\rho=0.4$ and $\alpha=2$ and $\beta=3$	(4 marks) (4 marks)	**7**
Q.5	i.	Define PSO and compare PSO with GA Also mentioning it advantage and limitations	(2 marks) (2 marks)	**4**
	ii.	Initialization Perform for two iteration.	(2 marks) (2 marks each)	**6**
OR	iii.	Initialization Two iterations	(2 marks) (2 marks each)	**6**
Q.6		Attempt any two:		
	i.	Any five comparison	(1 mark each)	**5**
	ii.	Forging theory Foraging behaviour	(3 marks) (2 marks)	**5**
	iii.	Reproduction Elimination Dispersal	(2 marks) (2 marks) (1 mark)	**5**

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