# Question Paper

Exam Date & Time: 05-Dec-2023 (02:30 PM - 05:30 PM)

## MANIPAL ACADEMY OF HIGHER EDUCATION

SEVENTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOV / DEC 2023

**Natural Computing [ICT 4051]**

**Marks: 50** **Duration: 180 mins.**

**A**

**Answer all the questions.** Section Duration: 180 mins

**Instructions to Candidates:**
**1. Answer ALL questions Missing data may be suitably assumed.**
**2. Answers without necessary steps carry ZERO marks**

| | | | |
|---|---|---|---|
| 1) | | Is PDA to accept strings in which number of a's is greater than number of b's deterministic? Justify. Mention all the components of the above PDA | (5) |
| | A) | | |
| | B) | Examine the DNA splicing system by providing a detailed example. Discuss the specific steps involved in the splicing process, including how various elements within the DNA sequence are identified, removed, or rearranged, and elucidate the resultant changes in the genetic information. | (3) |
| | C) | Given two parent chromosomes in a genetic algorithm: Parent 1 = "1010101010" and Parent 2 = "0101010101". Apply a two-point crossover at positions 3 and 7. After crossover, randomly insert a new gene, "1111" at position 5 in each offspring chromosome. Show the resulting offspring chromosomes. | (2) |
| 2) | | Construct a DFA which accepts binary strings of zeros and ones and represents 0 mod 5. Mention all the components of the DFA. | (5) |
| | A) | | |
| | B) | Examine the distinctions between Roulette wheel selection and tournament selection in genetic algorithms, providing examples to illustrate the unique characteristics of each method. | (3) |
| | C) | Analyze the DNA sticker model by detailing the sequence of four key operations performed on a test tube. | (2) |
| 3) | | Discuss how to use PSO for permutation problems by using TSP as an example to illustrate your answer. | (5) |
| | A) | | |
| | B) | Compare and contrast peptide computing with DNA computing. Focus on the distinctive features of each approach, including their molecular structures, mechanisms of computation, and the types of problems they are best suited to solve. | (3) |
| | C) | Consider an NFA N1=(Q,Σ,δ,p,F1) with language L1=L(N1), Define a new NFA N2=(Q,Σ,δ,p,F2) with the set of final states F2=Q–F1. Prove or disprove the following statement: The language L2=L(N2) is the complement of the language L1, i.e., L2=Σ*–L1. | (2) |
| 4) | | Analyze how evolutionary computation can be applied for feature selection in a large healthcare dataset to improve the performance of a predictive model. Detail the process from initialization to | (5) |

A) convergence.

B) Analyze the utilization of quantum entanglement in the behavior of qubits. Evaluate the process through which entanglement generates entangled qubit states and contrast these states with the properties of classical bits. (3)

C) Construct a CFG for a language L = { $wCw^R$ | where w ϵ (a, b)*}. (2)

5) Examine and compare the suitability of different chromosome encoding techniques for each of the Knapsack problem, the Travelling Salesman problem, finding weights for a neural network, and finding a function from given values. Specifically, analyze how each encoding method can be effectively applied to solve the mentioned problems. Illustrate your analysis with examples for each case. (5)

A)

B) Discuss the function of pheromone reinforcement in the Ant Colony Optimization algorithm. Assess its impact on steering the algorithm toward effective solutions. Demonstrate this principle with a scenario depicting the evolution of pheromone trails in the course of the algorithm's execution. (3)

C) Give regular expressions that generate each of the following languages. In all cases, the alphabet is Σ={a,b}. (2)

i) The language {w | w contains atleast two a's, or exactly two b's}.

ii) The language {w ∈ Σ∗ | |w| is odd}.

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