EASTERN MEDITERRANEAN UNIVERSITY
COMPUTER ENGINEERING DEPARTMENT
CMPE536 METAHEURISTICS
SAMPLE QUESTIONS

Q.1. Generalized TSP problem. The generalized traveling salesman problem (GTSP) is a generalization of the well-known traveling salesman problem. Given an undirected complete graph $G = (V,E)$, where V represents the set of cities, in the GTSP, the set of nodes V is partitioned into $\boldsymbol{m}$ groups $W_1,W_2, \ldots ,W_m$ where $0 < m \leq n$ and $W_1 \cup W_2 \cup \cdots \cup W_m = V$. Each city $v_i \in V$ belongs to one and only one group. The groups are disjoint, that is, $\forall i \neq j, W_i \cap W_j = \emptyset$. The objective is to find a minimum-length tour containing exactly one node from each group W_i.

Describe a solution procedure for the solution of this problem using the simulated annealing (SA) method. Describe, solution representation, SA algorithm parameters and data structures, and the fitness function clearly.

Q.2. (Bin Packing) Consider a finite set U of N items, with a size vector S such that $S(i) \in Z^+$ denotes the size of item i, i=1,...,N. Also, there bins of uniform capacity B and our objective is to pack items in U using minimum number of bins, without exceeding the bin capacity B in every used bin.

A. Describe a solution procedure for the solution of this problem using Genetic Algorithms.

Q.3. **A)** Consider the 0/1 Knapsack problem and describe how GA optimization can be applied for its solution. Describe representation, operators, generation of new individuals and population update methods clearly.

Q4. You are given a function f(x) defined on [1,n]. The problem is to find the number x* for which f is minimum. Write a local serach algorithm to find f(x*) or approach it.

Q.5. What is class NP?

Q6. Difference(s) Between Stocastic and Deterministic Optimizations.

Q.7. Explain the difference between a genotypic representation and a phenotypic representation. Give an example of each.

Q.8. Describe the roulette wheel parent selection technique. Ensure that you also give a suitable algorithm.

Q9. What is Local Search? Give examples.

Q10. Sample Question: Local Search Algorithms for TSP

Consider the following TSP instance with 4 cities: A, B, C, D. The symmetric distance matrix is provided below:

	A	**B**	**C**	**D**
A	0	10	15	20
B	10	0	35	25
C	15	35	0	30
D	20	25	30	0

a) Start with the initial tour **A-B-C-D-A** (total distance = 10 + 35 + 30 + 20 = 95). Apply the Hill Climbing algorithm using the **2-opt swap** neighborhood.

- List all possible neighboring tours generated by a single 2-opt swap from the initial tour.
- Compute their total distances.
- Determine the next tour selected by Hill Climbing.

b) Does Hill Climbing find the **optimal tour** in this case? If not, explain why and suggest an alternative Local Search method to address the issue.

c) What is the **time complexity** of generating all 2-opt neighbors for a TSP instance with n*n* cities? How does this affect Hill Climbing's applicability to large-scale TSP instances?