1. Genetic Algorithm **1BM22CS251**

```
import numpy as np

# Parameters
population_size = 100
generations = 50
mutation_rate = 0.1
crossover_rate = 0.7
range_min = -10
range_max = 10

# Fitness function
def fitness(x):
    return x**2

# Initialization of the population
def initialize_population(size, range_min, range_max):
    return np.random.uniform(range_min, range_max, size)

# Selection using roulette wheel selection
def select_parents(population):
    fitness_values = fitness(population)
    total_fitness = np.sum(fitness_values)
    selection_probs = fitness_values / total_fitness
    selected_indices = np.random.choice(len(population), size=2,
p=selection_probs)
    return population[selected_indices]

# Crossover to create offspring
def crossover(parent1, parent2):
    if np.random.rand() < crossover_rate:
        return (parent1 + parent2) / 2  # Simple average crossover
    return parent1  # No crossover occurs

# Mutation
def mutate(offspring, range_min, range_max):
    if np.random.rand() < mutation_rate:
        return np.random.uniform(range_min, range_max)
    return offspring

# Genetic Algorithm function
def genetic_algorithm():
    # Step 1: Initialize population
```

```python
    population = initialize_population(population_size, range_min,
range_max)

    for generation in range(generations):
        new_population = []

        # Step 2: Create new population
        for _ in range(population_size):
            parent1, parent2 = select_parents(population)
            child = crossover(parent1, parent2)
            child = mutate(child, range_min, range_max)
            new_population.append(child)

        population = np.array(new_population)

    # Return the best solution found
    best_solution = population[np.argmax(fitness(population))]
    return best_solution, fitness(best_solution)

# Running the genetic algorithm
best_x, best_fitness = genetic_algorithm()
print(f"Best x: {best_x}, Maximum f(x): {best_fitness}")
```

Output:

```
Best x: 9.677365496658311, Maximum f(x): 93.65140295591276
```