Batch: SC-5 Roll No.:16010123022
Experiment No. 10
Grade: AA / AB / BB / BC / CC / CD /DD
Signature of the Staff In-charge with date

Title: Study of Genetic Algorithm and search space.

Aim : Study of Genetic Algorithm and search Space.

Expected Outcome of Experiment:

CO4 :

Books/ Journals/ Websites referred:

1. S. N. Sivanandam, S. N. Deepa, *Principles of Soft Computing*, Wiley India.
2. David E. Goldberg, *Genetic Algorithms in Search, Optimization, and Machine Learning*, Pearson Education.
3. https://towardsdatascience.com/genetic-algorithms-explained
4. https://www.geeksforgeeks.org/genetic-algorithms

Theory:

Genetic Algorithms (GAs) are optimization techniques inspired by natural evolution. They start with a population of potential solutions, each represented as a chromosome (a string of numbers or bits). Every chromosome is evaluated using a fitness function, which measures how well it solves the problem.

The fittest solutions are selected to reproduce, combining through crossover to create new offspring that inherit traits from both parents. Occasionally, mutation randomly alters parts of a chromosome to introduce variation and prevent stagnation.

This process repeats across generations, gradually improving the population until strong solutions emerge. GAs are particularly effective in large or complex search spaces, where checking every possible solution is impractical. They balance exploration (searching new areas) and exploitation (refining good solutions), making them ideal for rugged, multi-peaked optimization problems.

In short, genetic algorithms mimic evolution to efficiently find high-quality solutions in complex problem spaces where traditional methods struggle.

Post Lab Descriptive Questions:

1. Explain the solution of any other problem using Genetic Algorithm.

This is a simple optimization problem that shows how genetic algorithms (GAs) work. We want to maximize ($f(x) = x \sin(10\pi x) + 2$) for (x) in ([-1, 2]). Checking all values manually is impossible, so a GA searches intelligently.

We start with a population of 20 random (x) values. Each chromosome represents one (x). The fitness of each is ($f(x)$), where higher values mean better fitness. The best solutions are more likely to be selected as parents using methods like roulette wheel selection.

Crossover combines two parents (e.g., ($0.6x_1 + 0.4x_2$)) to create offspring, while mutation slightly alters values (e.g., ($x = 1.5 \to 1.53$)) to keep diversity. This process repeats for many generations, improving fitness and approaching the optimal solution.

GAs don't need calculus or derivatives and can handle complex, multi-peaked functions. They're widely used in areas like scheduling, design, and machine learning because of their flexibility and robustness.

Conclusion: Thus, we have successfully studied Genetic Algorithm.Through this experiment, we have gained a deeper understanding of how genetic algorithms work and why they are such a valuable tool in solving optimization problems. We learned that genetic algorithms draw inspiration from natural evolution, using concepts like selection, crossover, and mutation to evolve solutions over multiple generations.

Date: 30-10-2025 **Signature of faculty in-charge**