CODE:

```
import sys

# Define the graph as an adjacency matrix
graph = [  [-1, 10, 15, 20], [10, -1, 35, 25], [15, 35, -1, 30], [20, 25, 30, -1]  ]

# Function to calculate the total cost of a path
def total_cost(path):
    cost = 0
    for i in range(len(path) - 1):
        cost += graph[path[i]][path[i + 1]]
    cost += graph[path[-1]][path[0]]  # Return to the starting city
    return cost

# Function to implement the A* algorithm for TSP
def a_star_tsp(graph):
    num_cities = len(graph)
    all_cities = set(range(num_cities))

    # Initialize the priority queue with (initial_node, g_cost, h_cost)
    pq = [(0, [0], [0] * num_cities)]
    best_path = None
    min_f_cost = sys.maxsize

    while pq:
        _, current_path, h_costs = pq.pop(0)
        current_city = current_path[-1]

        if len(current_path) == num_cities:
            current_path_cost = total_cost(current_path)
            if current_path_cost < min_f_cost:
                min_f_cost = current_path_cost
                best_path = current_path
        else:
            for next_city in all_cities - set(current_path):
                h_costs_copy = h_costs[:]
                h_costs_copy[next_city] = min(graph[current_city])
                f_cost = total_cost(current_path + [next_city]) + sum(h_costs_copy)

                if f_cost < min_f_cost:
                    new_path = current_path + [next_city]
                    pq.append((f_cost, new_path, h_costs_copy))
                    pq.sort(key=lambda x: x[0])  # Sort by f_cost for best-first behavior

    return best_path, min_f_cost
```

```
# Main function
if __name__ == "__main__":
    shortest_path, total_cost = a_star_tsp(graph)
    shortest_path.append(shortest_path[0])
    print(f"Shortest Path: {shortest_path}")
    print(f"Total Cost: {total_cost}")
```

OUTPUT:

```
PS C:\Users\shrey\OneDrive\Desktop\Projects\micro_project> & C:/Users/shrey/AppData/Local/Programs/Python/Python311/python.ex
e c:/Users/shrey/OneDrive/Desktop/programs/Python/AI5.py
Shortest Path: [0, 2, 1, 3, 0]
Total Cost: 74
PS C:\Users\shrey\OneDrive\Desktop\Projects\micro_project>
```