Лабораторна робота №5

з дисципліни

«Дискретна математика»

Виконала:

студентка групи КН-112

Яцунда Софія

**Викладач:**

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Н.І.

Львів – 2019р.

Тема: Знаходження найкоротшого маршруту за алгоритмом Дейкстри. Плоскі планарні графи

Мета роботи: набуття практичних вмінь та навичок з використання алгоритму Дейкстри.

Варіант 16

Завдання № 1. Розв'язати на графах наступні 2 задачі:

1. За допомогою алгоритму Дейкстра знайти найкоротший шлях у графі поміж парою вершин V0 і V* .
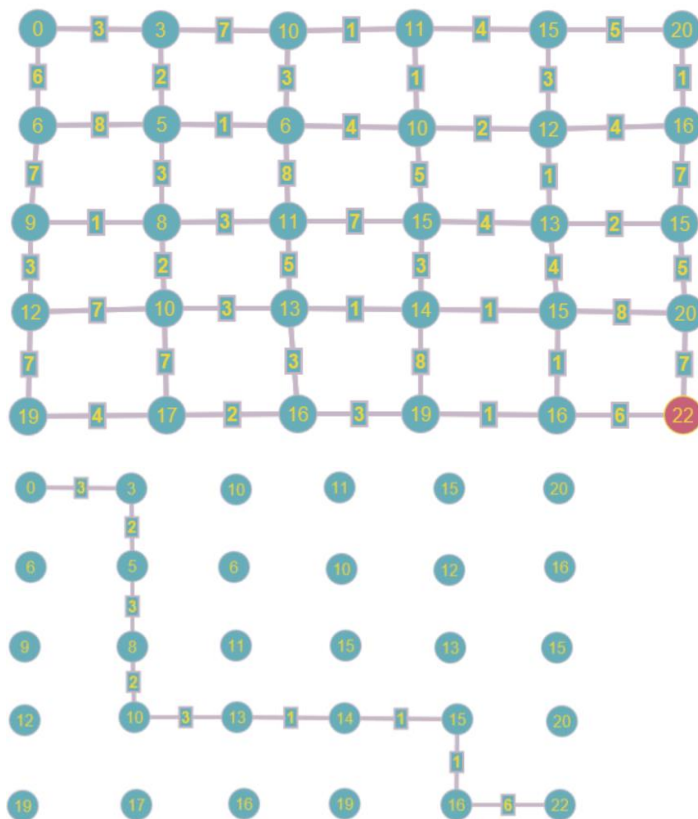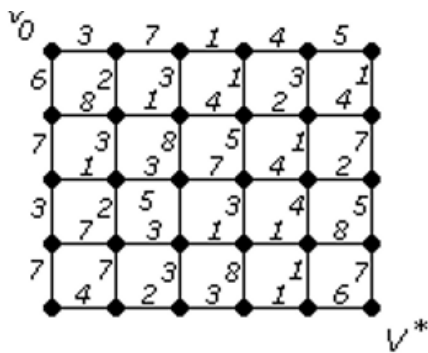
За допомогою γ-алгоритма зробити укладку графа у площині, або довести пти що вона неможлива.
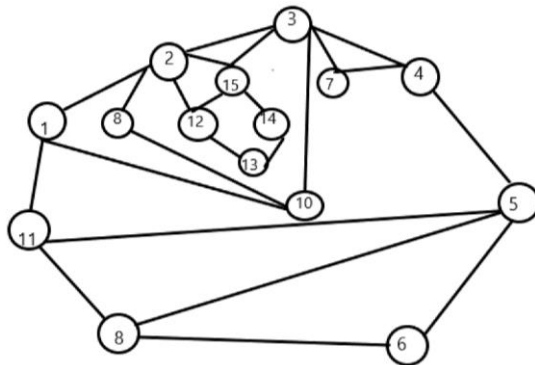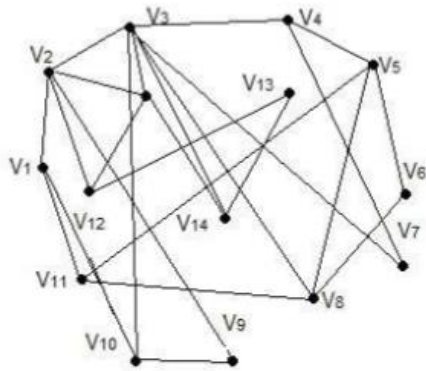
Завдання №2. Написати програму, яка реалізує алгоритм Дейкстри знаходження найкоротшого шляху між парою вершин у графі. Протестувати розроблену програму на графі згідно свого варіанту.
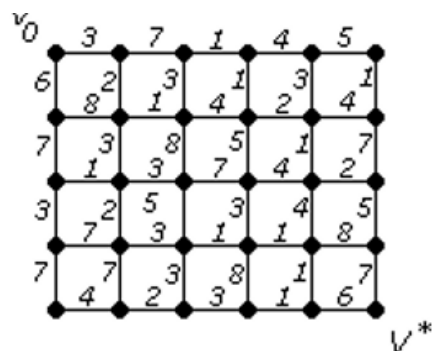

```cpp
#define _CRT_SECURE_NO_WARNINGS
#include <stdio.h>
#include <stdlib.h>
#include <iostream>
using namespace std;
#define SIZE 30
int main()
{
    int a[SIZE][SIZE];
    int d[SIZE];
    int v[SIZE];
    int temp, minindex, min;
    int begin_index = 0;
    system("chcp 1251");
    system("cls");

    for (int i = 0; i < SIZE; i++)
    {
        a[i][i] = 0;
        for (int j = i + 1; j < SIZE; j++) {
            cout << "Enter the weight of edges " << i + 1 << " - " << j + 1<<" : ";
            cin >> temp;
            a[i][j] = temp;
            a[j][i] = temp;
        }
```

```cpp
26          }
27
28          for (int i = 0; i < SIZE; i++)
29          {
30              d[i] = 10000;
31              v[i] = 1;
32          }
33          d[begin_index] = 0;
34          // Algorithm
35          do {
36              minindex = 10000;
37              min = 10000;
38              for (int i = 0; i < SIZE; i++){
39                  if ((v[i] == 1) && (d[i] < min)){
40                      min = d[i];
41                      minindex = i;
42                  }
43              }
44
45              if (minindex != 10000)
46              {
47                  for (int i = 0; i < SIZE; i++)
48                  {
49                      if (a[minindex][i] > 0)
```

```cpp
50                      {
51                          temp = min + a[minindex][i];
52                          if (temp < d[i])
53                          {
54                              d[i] = temp;
55                          }
56                      }
57                  }
58                  v[minindex] = 0;
59              }
60          } while (minindex < 10000);
61
62          cout << "The minimum way to the tops: ";
63          for (int i = 0; i < SIZE; i++)
64              cout<< d[i]<<"; ";
65
66
67          int ver[SIZE];
68          int end = 29;
69          ver[0] = end + 1;
70          int k = 1;
71          int weight = d[end];
72
```

```cpp
73          while (end != begin_index)
74          {
75              for (int i = 0; i < SIZE; i++)
76                  if (a[end][i] != 0)
77                  {
78                      int temp = weight - a[end][i];
79                      if (temp == d[i])
80                      {
81                          weight = temp;
82                          end = i;
83                          ver[k] = i + 1;
84                          k++;
85                      }
86                  }
87          }
88          cout << endl;
89          cout<< "The minimum way: ";
90          for (int i = k - 1; i >= 0; i--)
91              cout<< ver[i]<<"-";
92          getchar(); getchar();
93          return 0;
94      }
```

Enter the weight of edges 1 - 2 : 3
Enter the weight of edges 1 - 3 : 0
Enter the weight of edges 1 - 4 : 0
Enter the weight of edges 1 - 5 : 0
Enter the weight of edges 1 - 6 : 0
Enter the weight of edges 1 - 7 : 6
Enter the weight of edges 1 - 8 : 0
Enter the weight of edges 1 - 9 : 0
Enter the weight of edges 1 - 10 : 0
Enter the weight of edges 1 - 11 : 0
Enter the weight of edges 1 - 12 : 0
Enter the weight of edges 1 - 13 : 0
Enter the weight of edges 1 - 14 : 0
Enter the weight of edges 1 - 15 : 0
Enter the weight of edges 1 - 16 : 0
Enter the weight of edges 1 - 17 : 0
Enter the weight of edges 1 - 18 : 0
Enter the weight of edges 1 - 19 : 0
Enter the weight of edges 1 - 20 : 0
Enter the weight of edges 1 - 21 : 0
Enter the weight of edges 1 - 22 : 0
Enter the weight of edges 1 - 23 : 0
Enter the weight of edges 1 - 24 : 0
Enter the weight of edges 1 - 25 : 0
Enter the weight of edges 1 - 26 : 0
Enter the weight of edges 1 - 27 : 0
Enter the weight of edges 1 - 28 : 0
Enter the weight of edges 1 - 29 : 0
Enter the weight of edges 1 - 30 : 0
Enter the weight of edges 2 - 3 : 7

Enter the weight of edges 2 - 4 : 0
Enter the weight of edges 2 - 5 : 0
Enter the weight of edges 2 - 6 : 0
Enter the weight of edges 2 - 7 : 0
Enter the weight of edges 2 - 8 : 2
Enter the weight of edges 2 - 9 : 0
Enter the weight of edges 2 - 10 : 0
Enter the weight of edges 2 - 11 : 0
Enter the weight of edges 2 - 12 : 0
Enter the weight of edges 2 - 13 : 0
Enter the weight of edges 2 - 14 : 0
Enter the weight of edges 2 - 15 : 0
Enter the weight of edges 2 - 16 : 0
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Enter the weight of edges 2 - 19 : 0
Enter the weight of edges 2 - 20 : 0
Enter the weight of edges 2 - 21 : 0
Enter the weight of edges 2 - 22 : 0
Enter the weight of edges 2 - 23 : 0
Enter the weight of edges 2 - 24 : 0
Enter the weight of edges 2 - 25 : 0
Enter the weight of edges 2 - 26 : 0
Enter the weight of edges 2 - 27 : 0
Enter the weight of edges 2 - 28 : 0
Enter the weight of edges 2 - 29 : 0
Enter the weight of edges 2 - 30 : 0
Enter the weight of edges 3 - 4 : 1
Enter the weight of edges 3 - 5 : 0
Enter the weight of edges 3 - 6 : 0

Enter the weight of edges 3 - 7 : 0
Enter the weight of edges 3 - 8 : 0
Enter the weight of edges 3 - 9 : 3
Enter the weight of edges 3 - 10 : 0
Enter the weight of edges 3 - 11 : 0
Enter the weight of edges 3 - 12 : 0
Enter the weight of edges 3 - 13 : 0
Enter the weight of edges 3 - 14 : 0
Enter the weight of edges 3 - 15 : 0
Enter the weight of edges 3 - 16 : 0
Enter the weight of edges 3 - 17 : 0
Enter the weight of edges 3 - 18 : 0
Enter the weight of edges 3 - 19 : 0
Enter the weight of edges 3 - 20 : 0
Enter the weight of edges 3 - 21 : 0
Enter the weight of edges 3 - 22 : 0
Enter the weight of edges 3 - 23 : 0
Enter the weight of edges 3 - 24 : 0
Enter the weight of edges 3 - 25 : 0
Enter the weight of edges 3 - 26 : 0
Enter the weight of edges 3 - 27 : 0
Enter the weight of edges 3 - 28 : 0
Enter the weight of edges 3 - 29 : 0
Enter the weight of edges 3 - 30 : 0
Enter the weight of edges 4 - 5 : 4
Enter the weight of edges 4 - 6 : 0
Enter the weight of edges 4 - 7 : 0
Enter the weight of edges 4 - 8 : 0
Enter the weight of edges 4 - 9 : 0
Enter the weight of edges 4 - 10 : 1

Enter the weight of edges 4 - 11 : 0
Enter the weight of edges 4 - 12 : 0
Enter the weight of edges 4 - 13 : 0
Enter the weight of edges 4 - 14 : 0
Enter the weight of edges 4 - 15 : 0
Enter the weight of edges 4 - 16 : 0
Enter the weight of edges 4 - 17 : 0
Enter the weight of edges 4 - 18 : 0
Enter the weight of edges 4 - 19 : 0
Enter the weight of edges 4 - 20 : 0
Enter the weight of edges 4 - 21 : 0
Enter the weight of edges 4 - 22 : 0
Enter the weight of edges 4 - 23 : 0
Enter the weight of edges 4 - 24 : 0
Enter the weight of edges 4 - 25 : 0
Enter the weight of edges 4 - 26 : 0
Enter the weight of edges 4 - 27 : 0
Enter the weight of edges 4 - 28 : 0
Enter the weight of edges 4 - 29 : 0
Enter the weight of edges 4 - 30 : 0
Enter the weight of edges 5 - 6 : 5
Enter the weight of edges 5 - 7 : 0
Enter the weight of edges 5 - 8 : 0
Enter the weight of edges 5 - 9 : 0
Enter the weight of edges 5 - 10 : 0
Enter the weight of edges 5 - 11 : 3
Enter the weight of edges 5 - 12 : 0
Enter the weight of edges 5 - 13 : 0
Enter the weight of edges 5 - 14 : 0
Enter the weight of edges 5 - 15 : 0

```
Enter the weight of edges 5 - 16 : 0     Enter the weight of edges 6 - 22 : 0     Enter the weight of edges 7 - 29 : 0     Enter the weight of edges 9 - 16 : 0
Enter the weight of edges 5 - 17 : 0     Enter the weight of edges 6 - 23 : 0     Enter the weight of edges 7 - 30 : 0     Enter the weight of edges 9 - 17 : 0
Enter the weight of edges 5 - 18 : 0     Enter the weight of edges 6 - 24 : 0     Enter the weight of edges 8 - 9 : 1      Enter the weight of edges 9 - 18 : 0
Enter the weight of edges 5 - 19 : 0     Enter the weight of edges 6 - 25 : 0     Enter the weight of edges 8 - 10 : 0     Enter the weight of edges 9 - 19 : 0
Enter the weight of edges 5 - 20 : 0     Enter the weight of edges 6 - 26 : 0     Enter the weight of edges 8 - 11 : 0     Enter the weight of edges 9 - 20 : 0
Enter the weight of edges 5 - 21 : 0     Enter the weight of edges 6 - 27 : 0     Enter the weight of edges 8 - 12 : 0     Enter the weight of edges 9 - 21 : 0
Enter the weight of edges 5 - 22 : 0     Enter the weight of edges 6 - 28 : 0     Enter the weight of edges 8 - 13 : 0     Enter the weight of edges 9 - 22 : 0
Enter the weight of edges 5 - 23 : 0     Enter the weight of edges 6 - 29 : 0     Enter the weight of edges 8 - 14 : 3     Enter the weight of edges 9 - 23 : 0
Enter the weight of edges 5 - 24 : 0     Enter the weight of edges 6 - 30 : 0     Enter the weight of edges 8 - 15 : 0     Enter the weight of edges 9 - 24 : 0
Enter the weight of edges 5 - 25 : 0     Enter the weight of edges 7 - 8 : 8      Enter the weight of edges 8 - 16 : 0     Enter the weight of edges 9 - 25 : 0
Enter the weight of edges 5 - 26 : 0     Enter the weight of edges 7 - 9 : 0      Enter the weight of edges 8 - 17 : 0     Enter the weight of edges 9 - 26 : 0
Enter the weight of edges 5 - 27 : 0     Enter the weight of edges 7 - 10 : 0     Enter the weight of edges 8 - 18 : 0     Enter the weight of edges 9 - 27 : 0
Enter the weight of edges 5 - 28 : 0     Enter the weight of edges 7 - 11 : 0     Enter the weight of edges 8 - 19 : 0     Enter the weight of edges 9 - 28 : 0
Enter the weight of edges 5 - 29 : 0     Enter the weight of edges 7 - 12 : 0     Enter the weight of edges 8 - 20 : 0     Enter the weight of edges 9 - 29 : 0
Enter the weight of edges 5 - 30 : 0     Enter the weight of edges 7 - 13 : 7     Enter the weight of edges 8 - 21 : 0     Enter the weight of edges 9 - 30 : 0
Enter the weight of edges 6 - 7 : 0      Enter the weight of edges 7 - 14 : 0     Enter the weight of edges 8 - 22 : 0     Enter the weight of edges 10 - 11 : 2
Enter the weight of edges 6 - 8 : 0      Enter the weight of edges 7 - 15 : 0     Enter the weight of edges 8 - 23 : 0     Enter the weight of edges 10 - 12 : 0
Enter the weight of edges 6 - 9 : 0      Enter the weight of edges 7 - 16 : 0     Enter the weight of edges 8 - 24 : 0     Enter the weight of edges 10 - 13 : 0
Enter the weight of edges 6 - 10 : 0     Enter the weight of edges 7 - 17 : 0     Enter the weight of edges 8 - 25 : 0     Enter the weight of edges 10 - 14 : 0
Enter the weight of edges 6 - 11 : 0     Enter the weight of edges 7 - 18 : 0     Enter the weight of edges 8 - 26 : 0     Enter the weight of edges 10 - 15 : 0
Enter the weight of edges 6 - 12 : 1     Enter the weight of edges 7 - 19 : 0     Enter the weight of edges 8 - 27 : 0     Enter the weight of edges 10 - 16 : 5
Enter the weight of edges 6 - 13 : 0     Enter the weight of edges 7 - 20 : 0     Enter the weight of edges 8 - 28 : 0     Enter the weight of edges 10 - 17 : 0
Enter the weight of edges 6 - 14 : 0     Enter the weight of edges 7 - 21 : 0     Enter the weight of edges 8 - 29 : 0     Enter the weight of edges 10 - 18 : 0
Enter the weight of edges 6 - 15 : 0     Enter the weight of edges 7 - 22 : 0     Enter the weight of edges 8 - 30 : 0     Enter the weight of edges 10 - 19 : 0
Enter the weight of edges 6 - 16 : 0     Enter the weight of edges 7 - 23 : 0     Enter the weight of edges 9 - 10 : 4     Enter the weight of edges 10 - 20 : 0
Enter the weight of edges 6 - 17 : 0     Enter the weight of edges 7 - 24 : 0     Enter the weight of edges 9 - 11 : 0     Enter the weight of edges 10 - 21 : 0
Enter the weight of edges 6 - 18 : 0     Enter the weight of edges 7 - 25 : 0     Enter the weight of edges 9 - 12 : 0     Enter the weight of edges 10 - 22 : 0
Enter the weight of edges 6 - 19 : 0     Enter the weight of edges 7 - 26 : 0     Enter the weight of edges 9 - 13 : 0     Enter the weight of edges 10 - 23 : 0
Enter the weight of edges 6 - 20 : 0     Enter the weight of edges 7 - 27 : 0     Enter the weight of edges 9 - 14 : 0     Enter the weight of edges 10 - 24 : 0
Enter the weight of edges 6 - 21 : 0     Enter the weight of edges 7 - 28 : 0     Enter the weight of edges 9 - 15 : 8     Enter the weight of edges 10 - 25 : 0

Enter the weight of edges 10 - 26 : 0    Enter the weight of edges 12 - 19 : 0    Enter the weight of edges 14 - 16 : 0    Enter the weight of edges 16 - 17 : 4
Enter the weight of edges 10 - 27 : 0    Enter the weight of edges 12 - 20 : 0    Enter the weight of edges 14 - 17 : 0    Enter the weight of edges 16 - 18 : 0
Enter the weight of edges 10 - 28 : 0    Enter the weight of edges 12 - 21 : 0    Enter the weight of edges 14 - 18 : 0    Enter the weight of edges 16 - 19 : 0
Enter the weight of edges 10 - 29 : 0    Enter the weight of edges 12 - 22 : 0    Enter the weight of edges 14 - 19 : 0    Enter the weight of edges 16 - 20 : 0
Enter the weight of edges 10 - 30 : 0    Enter the weight of edges 12 - 23 : 0    Enter the weight of edges 14 - 20 : 2    Enter the weight of edges 16 - 21 : 0
Enter the weight of edges 11 - 12 : 4    Enter the weight of edges 12 - 24 : 0    Enter the weight of edges 14 - 21 : 0    Enter the weight of edges 16 - 22 : 0
Enter the weight of edges 11 - 13 : 0    Enter the weight of edges 12 - 25 : 0    Enter the weight of edges 14 - 22 : 0    Enter the weight of edges 16 - 23 : 3
Enter the weight of edges 11 - 14 : 0    Enter the weight of edges 12 - 26 : 0    Enter the weight of edges 14 - 23 : 0    Enter the weight of edges 16 - 24 : 0
Enter the weight of edges 11 - 15 : 0    Enter the weight of edges 12 - 27 : 0    Enter the weight of edges 14 - 24 : 0    Enter the weight of edges 16 - 25 : 0
Enter the weight of edges 11 - 16 : 0    Enter the weight of edges 12 - 28 : 0    Enter the weight of edges 14 - 25 : 0    Enter the weight of edges 16 - 26 : 0
Enter the weight of edges 11 - 17 : 1    Enter the weight of edges 12 - 29 : 0    Enter the weight of edges 14 - 26 : 0    Enter the weight of edges 16 - 27 : 0
Enter the weight of edges 11 - 18 : 0    Enter the weight of edges 12 - 30 : 0    Enter the weight of edges 14 - 27 : 0    Enter the weight of edges 16 - 28 : 0
Enter the weight of edges 11 - 19 : 0    Enter the weight of edges 13 - 14 : 1    Enter the weight of edges 14 - 28 : 0    Enter the weight of edges 16 - 29 : 0
Enter the weight of edges 11 - 20 : 0    Enter the weight of edges 13 - 15 : 0    Enter the weight of edges 14 - 29 : 0    Enter the weight of edges 16 - 30 : 0
Enter the weight of edges 11 - 21 : 0    Enter the weight of edges 13 - 16 : 0    Enter the weight of edges 14 - 30 : 7    Enter the weight of edges 17 - 18 : 2
Enter the weight of edges 11 - 22 : 0    Enter the weight of edges 13 - 17 : 0    Enter the weight of edges 15 - 16 : 7    Enter the weight of edges 17 - 19 : 0
Enter the weight of edges 11 - 23 : 0    Enter the weight of edges 13 - 18 : 0    Enter the weight of edges 15 - 17 : 0    Enter the weight of edges 17 - 20 : 0
Enter the weight of edges 11 - 24 : 0    Enter the weight of edges 13 - 19 : 3    Enter the weight of edges 15 - 18 : 0    Enter the weight of edges 17 - 21 : 0
Enter the weight of edges 11 - 25 : 0    Enter the weight of edges 13 - 20 : 0    Enter the weight of edges 15 - 19 : 0    Enter the weight of edges 17 - 22 : 0
Enter the weight of edges 11 - 26 : 0    Enter the weight of edges 13 - 21 : 0    Enter the weight of edges 15 - 20 : 0    Enter the weight of edges 17 - 23 : 4
Enter the weight of edges 11 - 27 : 0    Enter the weight of edges 13 - 22 : 0    Enter the weight of edges 15 - 21 : 5    Enter the weight of edges 17 - 24 : 0
Enter the weight of edges 11 - 28 : 0    Enter the weight of edges 13 - 23 : 0    Enter the weight of edges 15 - 22 : 0    Enter the weight of edges 17 - 25 : 0
Enter the weight of edges 11 - 29 : 0    Enter the weight of edges 13 - 24 : 0    Enter the weight of edges 15 - 23 : 0    Enter the weight of edges 17 - 26 : 0
Enter the weight of edges 11 - 30 : 0    Enter the weight of edges 13 - 25 : 0    Enter the weight of edges 15 - 24 : 0    Enter the weight of edges 17 - 27 : 0
Enter the weight of edges 12 - 13 : 0    Enter the weight of edges 13 - 26 : 0    Enter the weight of edges 15 - 25 : 0    Enter the weight of edges 17 - 28 : 0
Enter the weight of edges 12 - 14 : 0    Enter the weight of edges 13 - 27 : 0    Enter the weight of edges 15 - 26 : 0    Enter the weight of edges 17 - 29 : 0
Enter the weight of edges 12 - 15 : 0    Enter the weight of edges 13 - 28 : 0    Enter the weight of edges 15 - 27 : 0    Enter the weight of edges 17 - 30 : 0
Enter the weight of edges 12 - 16 : 0    Enter the weight of edges 13 - 29 : 0    Enter the weight of edges 15 - 28 : 0    Enter the weight of edges 18 - 19 : 0
Enter the weight of edges 12 - 17 : 0    Enter the weight of edges 13 - 30 : 0    Enter the weight of edges 15 - 29 : 0    Enter the weight of edges 18 - 20 : 0
Enter the weight of edges 12 - 18 : 7    Enter the weight of edges 14 - 15 : 3    Enter the weight of edges 15 - 30 : 0    Enter the weight of edges 18 - 21 : 0

Enter the weight of edges 18 - 22 : 0    Enter the weight of edges 21 - 22 : 1
Enter the weight of edges 18 - 23 : 0    Enter the weight of edges 21 - 23 : 0
Enter the weight of edges 18 - 24 : 5    Enter the weight of edges 21 - 24 : 0
Enter the weight of edges 18 - 25 : 0    Enter the weight of edges 21 - 25 : 0
Enter the weight of edges 18 - 26 : 0    Enter the weight of edges 21 - 26 : 0
Enter the weight of edges 18 - 27 : 0    Enter the weight of edges 21 - 27 : 3
Enter the weight of edges 18 - 28 : 0    Enter the weight of edges 21 - 28 : 0
Enter the weight of edges 18 - 29 : 0    Enter the weight of edges 21 - 29 : 0
Enter the weight of edges 18 - 30 : 0    Enter the weight of edges 21 - 30 : 0
Enter the weight of edges 19 - 20 : 7    Enter the weight of edges 22 - 23 : 1
Enter the weight of edges 19 - 21 : 0    Enter the weight of edges 22 - 24 : 0
Enter the weight of edges 19 - 22 : 0    Enter the weight of edges 22 - 25 : 0
Enter the weight of edges 19 - 23 : 0    Enter the weight of edges 22 - 26 : 0
Enter the weight of edges 19 - 24 : 0    Enter the weight of edges 22 - 27 : 0
Enter the weight of edges 19 - 25 : 7    Enter the weight of edges 22 - 28 : 8
Enter the weight of edges 19 - 26 : 0    Enter the weight of edges 22 - 29 : 0
Enter the weight of edges 19 - 27 : 0    Enter the weight of edges 22 - 30 : 0
Enter the weight of edges 19 - 28 : 0    Enter the weight of edges 23 - 24 : 8
Enter the weight of edges 19 - 29 : 0    Enter the weight of edges 23 - 25 : 0
Enter the weight of edges 19 - 30 : 0    Enter the weight of edges 23 - 26 : 0
Enter the weight of edges 20 - 21 : 3    Enter the weight of edges 23 - 27 : 0
Enter the weight of edges 20 - 22 : 0    Enter the weight of edges 23 - 28 : 0
Enter the weight of edges 20 - 23 : 0    Enter the weight of edges 23 - 29 : 1
Enter the weight of edges 20 - 24 : 0    Enter the weight of edges 23 - 30 : 0
Enter the weight of edges 20 - 25 : 0    Enter the weight of edges 24 - 25 : 0
Enter the weight of edges 20 - 26 : 7    Enter the weight of edges 24 - 26 : 0
Enter the weight of edges 20 - 27 : 0    Enter the weight of edges 24 - 27 : 0
Enter the weight of edges 20 - 28 : 0    Enter the weight of edges 24 - 28 : 0
Enter the weight of edges 20 - 29 : 0    Enter the weight of edges 24 - 29 : 0
Enter the weight of edges 20 - 30 : 0    Enter the weight of edges 24 - 30 : 7
Enter the weight of edges 25 - 26 : 4
Enter the weight of edges 25 - 27 : 0
Enter the weight of edges 25 - 28 : 0
Enter the weight of edges 25 - 29 : 0
Enter the weight of edges 25 - 30 : 0
Enter the weight of edges 26 - 27 : 2
Enter the weight of edges 26 - 28 : 0
Enter the weight of edges 26 - 29 : 0
Enter the weight of edges 26 - 30 : 0
Enter the weight of edges 27 - 28 : 3
Enter the weight of edges 27 - 29 : 0
Enter the weight of edges 27 - 30 : 0
Enter the weight of edges 28 - 29 : 1
Enter the weight of edges 28 - 30 : 0
Enter the weight of edges 29 - 30 : 6
The minimum way to the tops: 0; 3; 9; 10; 14; 17; 6; 5; 6; 10; 12; 16; 9; 8; 11; 15; 13; 15; 12; 10; 13; 14; 15; 20; 19;
17; 16; 17; 16; 22;
The minimum way: 1-2-8-14-20-21-22-23-29-30-
```

Висновок: Я набула практичних вмінь та навичок з використання алгоритму Дейкстри.