Assignment-02
50 marks. 2 Graph , 3 (DP+Greedy)

GRAPH-1

1. Dhaka, especially your area, is facing an Electricity crisis. Many initiatives including load shedding, reducing office hours, etc have already been taken. The local authority of your area is looking for feasible solutions to reduce the consumption of electricity. One of the members of their advisory committee has suggested that they should reduce the operating costs of road lighting. Till now every road is illuminated all night long. To reduce electricity consumption, they have decided to no longer illuminate every road, but to switch off the road lighting of some roads. To make sure that the inhabitants of your area still feel safe, they want to optimize the lighting in such a way that after darkening some roads at night, there will still be at least one illuminated path from every major point in your area to every other major point.
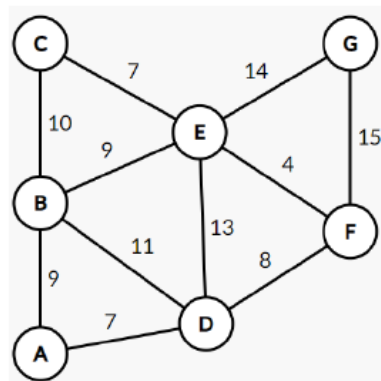

Figure : Graph of your area where the Vertices denote major points and Edges denote electricity consumption in a day.

a. **Apply** a suitable Algorithm to help the authority determine the roads they need to illuminate **6**
CO3 and the cost which will minimize the electricity consumption. If you need to consider any root vertex for your Algorithm, you can consider 'A' as such.

b. Observe the Graph of your area and your provided solution of question 1(a) and **determine** **1**
CO5 the maximum electricity of a day the authority can save.

c. The United Arab Emirates (UAE), especially Dubai, is hosting the Asia Cup 2022. They too **3**
CO6 want to minimize the electricity consumption by switching off the lights in some roads leaving exactly one illuminated path from every major point in your area to every other major point. However, to keep the tourists entertained, the Authority of Dubai has taken an opposite approach to yours. They want to illuminate the roads which require the most electricity.
Propose an algorithm to compute the path which fulfills this requirement.

GRAPH - 2

1 a.
CO3   As we all know, the Spanish National Football Team is notorious for their passing football,   **06**
especially their back passes. After their disastrous 2022 World Cup campaign, The King
of Spain made you the coach and declared that no back passes are allowed on the field
from now on till Spain scores 2 goals, that is, Simon the goalkeeper can only pass to the
defenders Rodri and Cesar, but Rodri and Cesar cannot pass the ball back to Simon.
Also, every pass now comes with a cost– and the more cost players accumulate, the
angrier the King gets. These are the costs of the passes:

Passes	Cost
Simon → Rodri	2
Simon → Cesar	4
Rodri → Cesar	1
Rodri → Pedri	7
Cesar → Gavi	3
Gavi → Pedri	2
Pedri → Morata	1
Gavi → Morata	5

Find the lowest cost for the ball to reach every player starting from Simon, using any
algorithm you find useful. The King will need to see every single step of the algorithm, or
he will not believe you and fire you on the spot.

b.
CO3   After scoring 2 goals, Spain changed their strategy and started to back pass again   **04**
incorporating 2 more players, the master of dark arts Busquets and the young sensation
Ansu Fati. Now they are no longer concerned with the cost of the pass as well. These are
the passes for the new strategy:

Passes
Simon → Rodri
Simon → Cesar
Rodri → Busquets
Rodri → Pedri
Cesar → Rodri
Busquets → Gavi
Busquets → Pedri
Gavi → Cesar
Gavi → Pedri
Gavi → Fati
Fati → Morata
Pedri → Fati
Morata → Pedri

Now using a suitable algorithm, **find** out the largest group of players who can pass the ball among themselves. For example, one such group can be (Fati, Morata, Pedri) where Morata can pass to Pedri, Pedri can pass to Fati and Fati can pass to Morata. It is important to keep in mind that the king will be observing every step of the algorithm. Any discrepancies can lead you to lose your job.

Greedy-1

2 a.
CO2   You are given the following table containing symbols and their frequencies:

Symbol	A	B	C	D	+
Frequency	40	10	20	15	15

      i)   **Build** the Huffman code tree and find the codewords for each character.   **04**
      ii)   **Decode** 100010111001010 using the Huffman code that you generated.   **01**

b.
CO4   You are given the arrival and departure times of eight trains for a railway platform, each in the following format: [$arrival\ time,\ departure\ time$). Only one train can use the platform at a time.

Suppose, you have got the following train-use requests for the next day.

      { [8, 13), [6, 9), [11, 14), [2, 7), [1, 7), [12, 20), [7, 13) , [13, 20) }

      i)   **Find** the maximum number of trains that can use the platform without any collision.   **03**
      ii)   **Determine** the minimum number of platforms that needs to be there to ensure the   **02**
            arrival and departure of all these trains without collision.

Greedy + DP

3   A team of two infamous thieves, Denver and Nairobi, planned to rob the famous Louvre Museum. Before the scene, they both agreed on the fact that none of them will break any item as all the items in the Louvre are too precious, and taking a fraction of any item won't sell in the black market. If it fits in the bag as a whole, they will take it, otherwise, leave it as it is.

Both of them arrived at the Louvre with an empty knapsack weighing a total of 8 kg. Despite the fact that both thieves are experts in their fields, they take slightly different approaches. Denver believes he will use a Dynamic Programming Approach to rob the items in the most efficient manner possible. Nairobi, on the other hand, believes that if she chooses a Greedy Approach, she will make the most money.

The objects in the Louvre Museum are listed below.

Objects	Jewelry	Sculpture	Painting	Book	Mummy
Profit ($)	5	9	5	4	6
Weight (Kg)	3	5	4	1	12

CO4   i)   **Calculate** the maximum profit Denver can make using his strategy. What items did he pick up? **Show** how Denver used the DP table to select these objects. You may use arrows and circles to point to the chosen cells.   **08**

CO4   ii) Does Nairobi's belief remain valid after the robbery? **Prove** it.   **02**

DP-1

3. Today Alice has learned how to find the Longest Common Subsequence (LCS) of two given strings. Now she wants to find the LCS of "axyb" and "abyxb". After hours of hard work, she has made this LCS table, M.

	empty	a	b	y	x	b
empty	0	0	0	0	0	0
a	0	1	1	1	1	1
x	0	1	1	1	2	2
y	0	1	1	2	2	2
b	0	1	2	2	2	3

a. **Explain** what you understand by the value M[3][4] = 2.   2
CO1

b. **Find** out the LCS String from the table. Show the steps of your work.   3
CO2

c. **Determine** the maximum profit for the 0-1 Knapsack problem given in the following table   5
CO4 using Dynamic Programming. Show the steps with a recursion tree or the memory matrix.

Knapsack Weight: 8 kg

Objects	i	ii	iii	iv
Weight (kg)	5	4	6	3
Profit ($)	11	10	12	9