

QQQ – Decision 2 – Chapter 4 – Flows in Networks 2 (Version 2)

Total Marks: 24

(24 = Platinum, 22 = Gold, 19 = Silver, 16 = Bronze)

1.

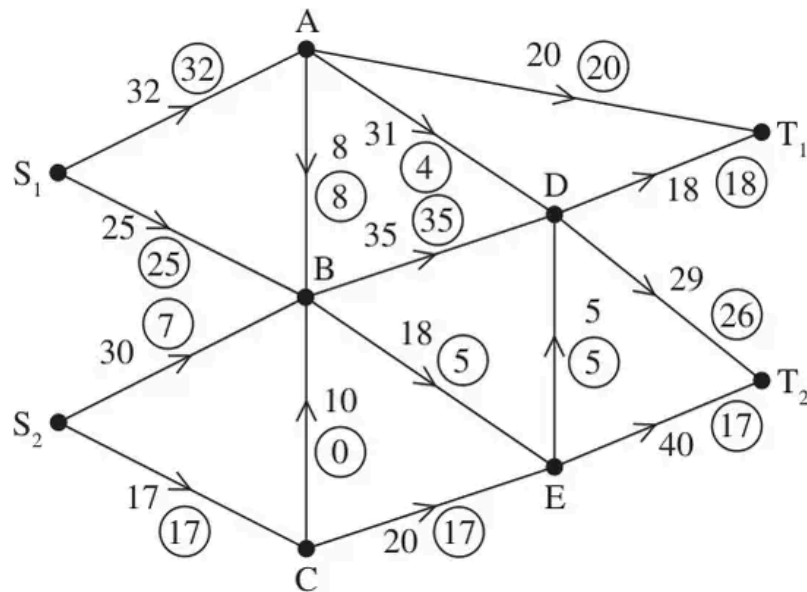


Figure 1

Figure 1 shows a capacitated, directed network. The number on each arc represents the capacity of that arc. The numbers in circles represent an initial flow.

- (a) (i) Add a supersource, S, and a supersink, T, and corresponding arcs to Diagrams 1 and 2, in the answer book. **(3)**
- (ii) Enter the flow value and appropriate capacity on each of the arcs you have added to Diagram 1.
- (b) Complete the initialisation of the labelling procedure on Diagram 2 by entering values along the new arcs from S and T, and along AB, AD and DT₂. **(2)**
- (c) Hence use the labelling procedure to find a maximum flow through the network. You must list each flow-augmenting route you use, together with its flow. **(4)**
- (d) Draw a maximal flow pattern on Diagram 3 in the answer book. **(2)**
- (e) Prove that your flow is maximal. **(2)**

(Total 13 marks)

2.

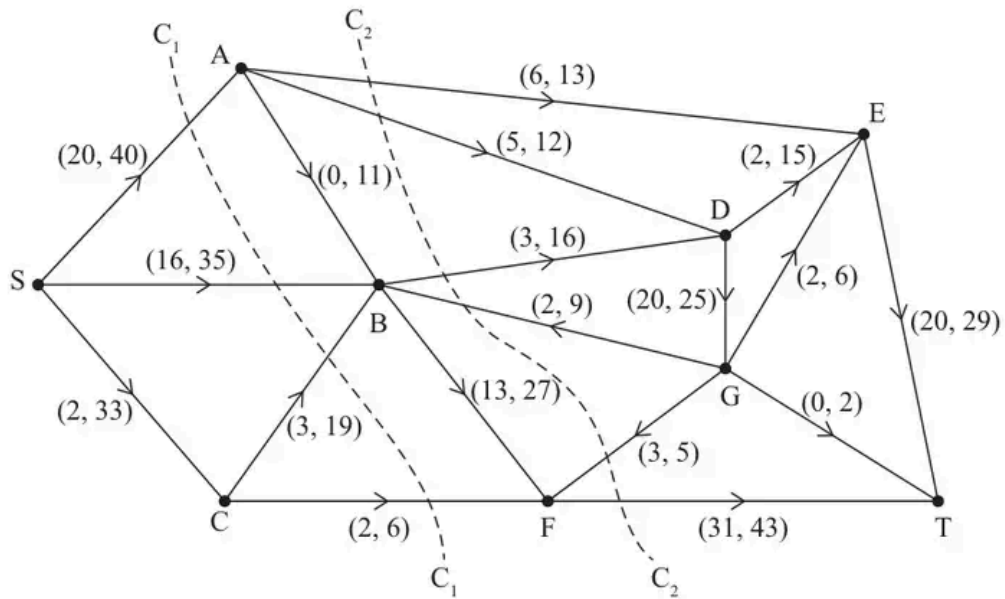


Figure 2

Figure 2 shows a capacitated, directed network. The network represents a system of pipes through which fluid can flow.

The weights on the arcs show the lower and upper capacities for the corresponding pipes, in litres per second.

(a) Calculate the capacity of

(i) cut C_1

(ii) cut C_2 **(2)**

(b) Using only the capacities of cuts C_1 and C_2 , state what can be deduced about the maximum flow through the system. **(1)**

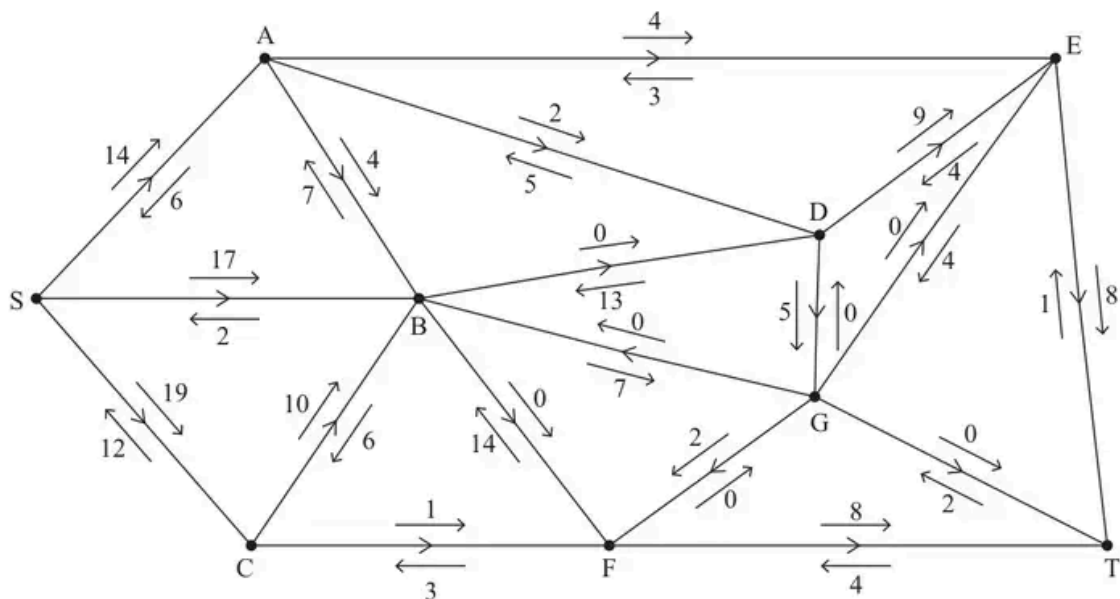


Figure 3

A scientist monitors the system of pipes in which a fluid now flows from the source, S, to the sink, T.

The scientist initialises the labelling procedure for this system. The excess and potential backflows for this are shown on the arrows either side of each arc in Figure 3.

- (c) State the value of the initial flow. (1)
- (d) Use the labelling procedure to find a maximum flow through the network. You must list each flow-augmenting route you use, together with its flow. (3)
- (e) Use your answer to part (d) to find a maximum flow pattern for this system of pipes and draw it on Diagram 1 in the answer book. (1)

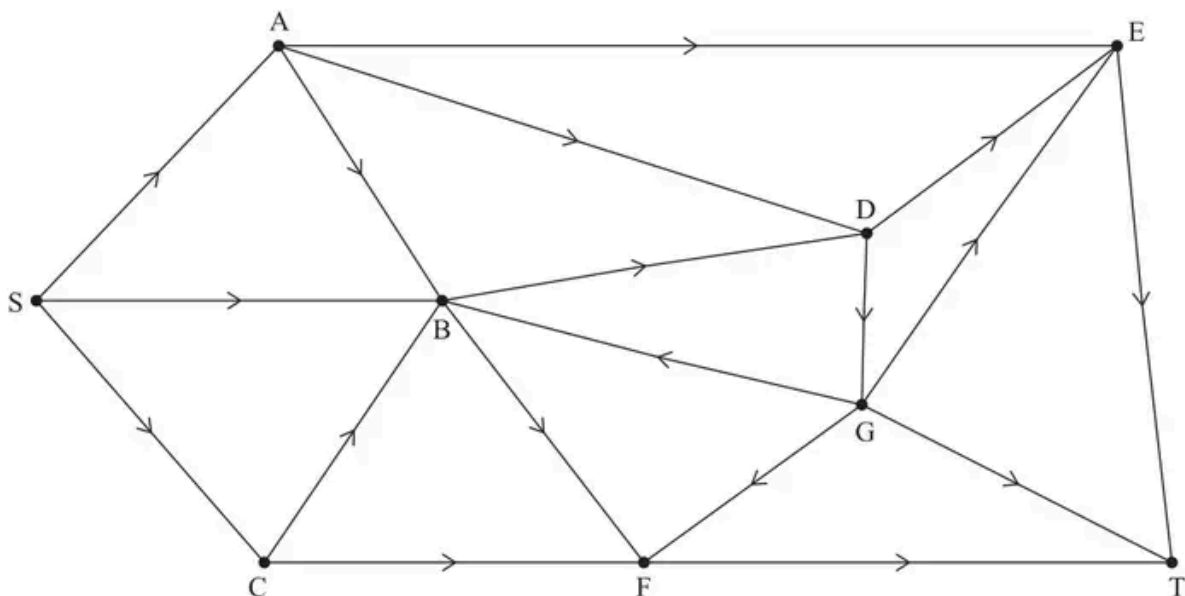


Diagram 1

(f) Prove that the answer to part (e) is optimal.

(3)

(Total 11 marks)

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