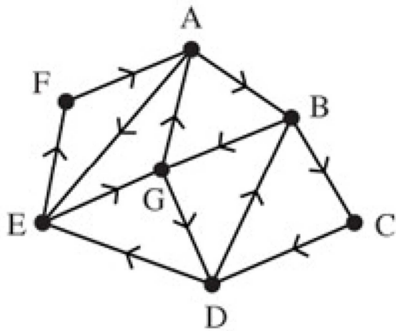


Route inspection 4B

1 a All valencies are even, so the network is traversable and can return to its start.



A possible route is:

A – B – C – D – B – G – D – E – G – A – E – F – A

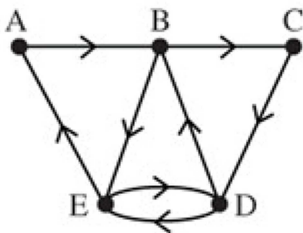
length of route = weight of network

$$= 285$$

b The valencies of D and E are odd, the rest are even.

We must repeat the shortest path between D and E, which is the direct path DE.

We add this extra arc to the diagram.



A possible route is:

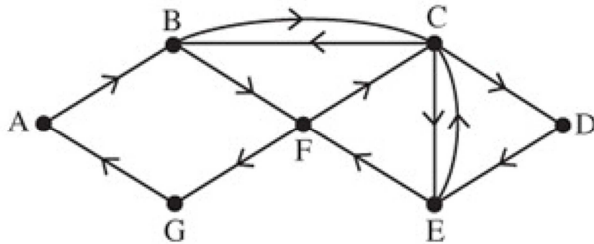
A – B – C – D – E – D – B – E – A

length of route = weight of network + arc DE

$$= 61 + 11$$

$$= 72$$

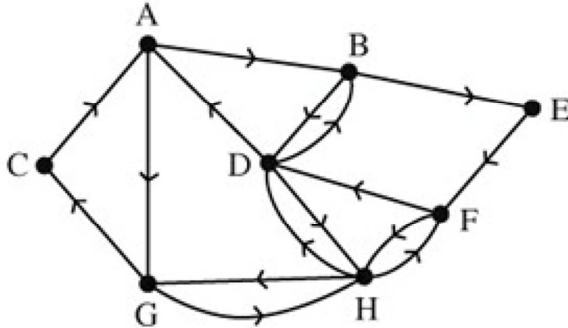
- 1 c** The degrees of B and E are odd, the rest are even.
 We must repeat the shortest path from B to E.
 By inspection this is BCE, length 260.
 We add these extra arcs to the diagram.



A possible route is:

$$\begin{aligned}
 &A - B - C - D - E - C - B - F - C - E - F - G - A \\
 \text{length of route} &= \text{weight of network} + \text{BCE} \\
 &= 1055 + 260 \\
 &= 1315
 \end{aligned}$$

- d** The order of B and G are odd, the rest are even.
 We must repeat the shortest path from B to G.
 By inspection this is BDHG, length 183.
 We add these arcs to the diagram.



A possible route is:

$$\begin{aligned}
 &A - B - E - F - D - B - D - A - G - H - F - H - D - H - G - C - A \\
 \text{length of route} &= \text{weight of network} + \text{BDHG} \\
 &= 995 + 183 \\
 &= 1178
 \end{aligned}$$

2 a Odd valencies at B, D, E and F.

Considering all possible pairings and their weights.

$$BD + EF = 130 + 85 = 215 \leftarrow \text{least weight}$$

$$BE + DF = 110 + 178 = 288$$

$$BF + DE = 125 + 93 = 218$$

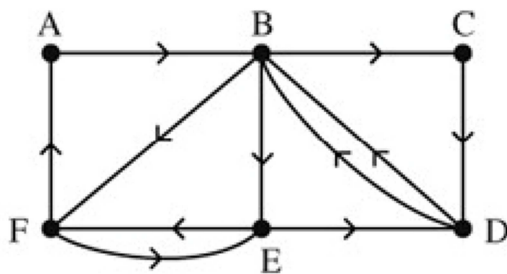
We need to repeat arcs BD and EF.

The length of the shortest route = weight of network + 215

$$= 908 + 215$$

$$= 1123$$

Adding BD and EF to the diagram gives.



A possible route is:

A - B - C - D - B - E - D - B - F - E - F - A

b Odd valencies at C, D, E and G

Considering all possible pairings and their weights

$$CD + EG = 130 + 75 = 205$$

$$CE + DG = 157 + 92 = 249$$

$$CG + DE = 82 + 120 = 202 \leftarrow \text{least weight}$$

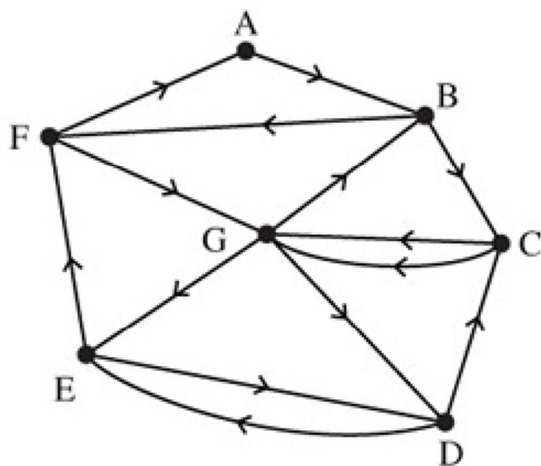
We need to repeat arcs CG and DE

The length of the shortest route = weight of network + 202

$$= 938 + 202$$

$$= 1140$$

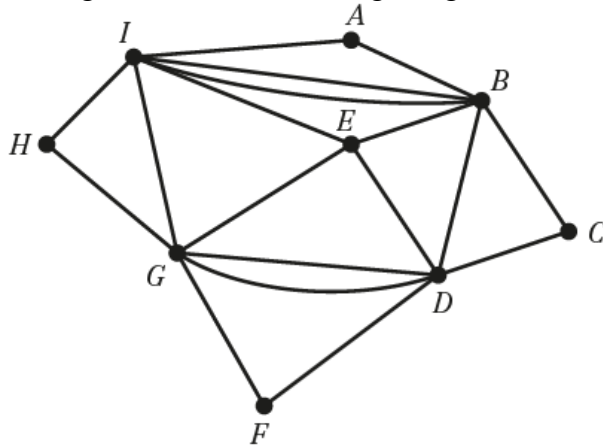
Adding CG and DE to the diagram gives.



A possible route is:

A - B - C - G - D - C - G - E - D - E - F - G - B - F - A

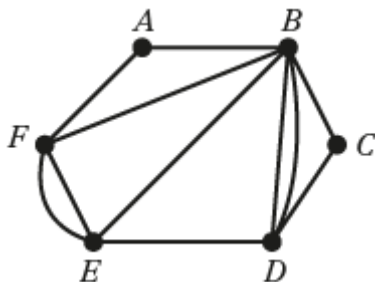
- 3 a** The odd nodes are B, D, G and I .
 The minimum path lengths for each pairing are:
 $BD + GI = 22 + 30 = 52$
 $BG + DI = 37 + 42 = 79$
 $BI + DG = 32 + 18 = 50$
 The arcs to be traversed twice are BI and DG .
 Adding BI and DG to the diagram gives:



A possible route is
 $A - B - C - D - B - I - E - B - I - G - D - F - G - E - D - G - H - I - A$.

- b** $BI + DG = 50$. So the minimum time = $326 + 50 = 376$ ms

- 4 a** Odd degrees are B, D, E and F .
 Considering all possible pairings and their weight
 $BD + EF = 250 + 200 = 450 \leftarrow$ least weight
 $BE + DF = 350 + 380 = 730$
 $BF + DE = 300 + 180 = 480$
 We need to repeat arcs BD and EF .
 Adding these to the diagram gives



A possible route is:
 $A - B - C - D - B - D - E - F - B - E - F - A$
 length = $1910 + 450 = 2360$ m

- b** We will still have two odd valencies.
 We need to select the pair that gives the least path.
 From part **a** our six choices are
 BD (250), EF (200), BE (350), DF (380), BF (300) and DE (180).
 The shortest is DE (180) so we choose to repeat this.
 It is the other two vertices (B and F) that will be our start and finish.
 For example, start at B , finish at F .
 length = $1910 + 180 = 2090$ m

- 5 a** Each arc must be traversed twice, whereas in the standard problem each arc need only be visited once.

This has the same effect as doubling up all the edges.

The length of the route = $2 \times$ weight of network

$$= 2 \times 89 = 178 \text{ km}$$

- b** Odd nodes C, D, E, G.

Consider all possible pairings.

$$CD + EG = 13 + 5 = 18$$

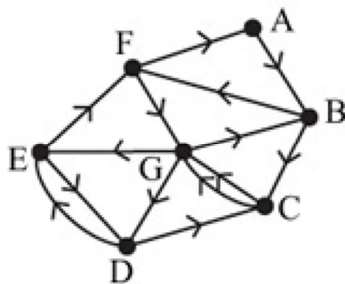
$$CE + DG = 15 + 3 = 18$$

$$CG + DE = 10 + 7 = 17 \leftarrow \text{least weight}$$

We need to repeat arcs CG and DE.

Adding these to the network.

Shortest routes
 CD is CGD
 CE is CGE



A possible route is:

A - B - C - G - D - C - G - E - D - E - F - G - B - F - A

$$\text{Length} = 89 + 17 = 106 \text{ km}$$

- c** If EG is omitted E and G become even and the only odd valencies are at C and D.
 We must repeat the shortest path between C and D, CGD.
 We no longer need to travel along EG so we can subtract 5 from the weight of the network.
 The new length = $(89 - 5) + 13 = 97 \text{ km}$