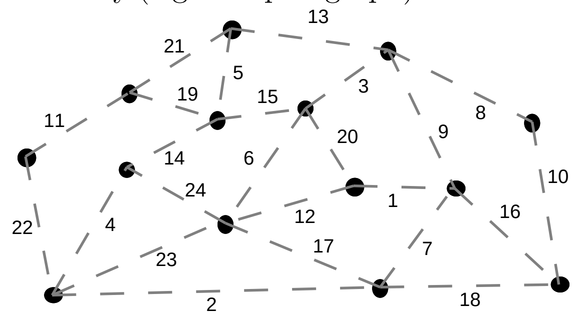
ECE 158B Midterm, Spring 1998

1. For the weighted undirected graph shown below, find a minimum weight spanning tree. Indicate your answer by darkening the edges in the spanning tree. Use one of the algorithms described in class, and briefly (e.g. one paragraph) describe the algorithm you used.



2. State briefly in your own words what the Distributed Asynchronous Bellman-Ford Routing algorithm is, and the actions required by each node executing the algorithm.

3. A form of the centralized Bellman-Ford routing algorithm is used on a weighted directed graph. There are seven nodes on the graph, labeled 1 through 7, with node 1 being the destination node. The graph may contain cycles of negative or zero weight, and is otherwise unknown. The algorithm starts from some arbitrary intial condition $\vec{D}_0 = (D_1^0, D_2^0, \cdots, D_7^0)$ which has non-negative components (not necessarily the same as in the Bellman-Ford algorithm). On the k^{th} iteration, the value of $\vec{D}_{k+1}$ is obtained from $\vec{D}_k$ by the equation $\vec{D}_{k+1} = \vec{f}(\vec{D}_k)$, where $\vec{f}(\vec{D}) = \vec{D}$ is Bellman's equation, as discussed in class. On the fourth and fifth iterations, the iterates obtained are as follows:

$$\begin{aligned} \vec{D}_4 &= (0, 4, 2, 9, 3, 8, 7) \\ \vec{D}_5 &= (0, 5, 2, 9, 5, 8, 9) \end{aligned}$$

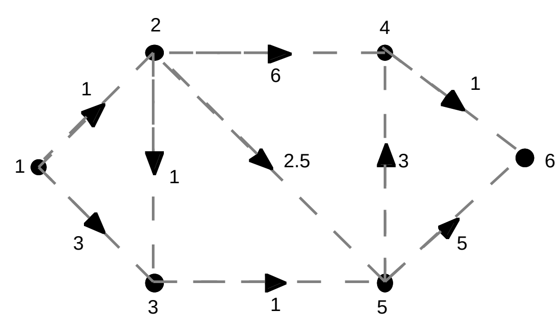
For each of the cases listed below, state whether or not it is possible to obtain the corresponding value of $\vec{D}_6$ at the sixth iteration, and indicate your reasoning clearly.

(a) $\vec{D}_6 = (0, 4, 2, 9, 3, 8, 7)$

(b) $\vec{D}_6 = (0, 5, 2, 9, 5, 8, 9)$

(c) $\vec{D}_6 = (0, 7, 3, 9, 6, 8, 9)$

4. For the weighted directed graph below, use Dijkstra's algorithm to find the lengths of shortest paths from node 1 to each other node. Document your work clearly. Indicate a shortest path tree emanating from node 1, by darkening the edges if they are in the shortest path



tree.

5. Suppose R_{in} and R_{out} are the arrival and departure processes to a network element. It is known that

$$R_{in}(t) = \begin{cases} 0 & \text{, if } t < 0 \\ 4t & \text{, if } 0 \le t \le 5 \\ 20 & \text{, if } t > 5 \end{cases}$$

and

$$R_{out}(t) = \begin{cases} 0 & \text{, if } t < 0 \\ t^2 & \text{, if } 0 \le t \le 4 \\ 4t & \text{, if } 4 < t \le 5 \\ 20 & \text{, if } t > 5 \text{ .} \end{cases}$$

Find the virtual delay, $D(t)$, for all t.