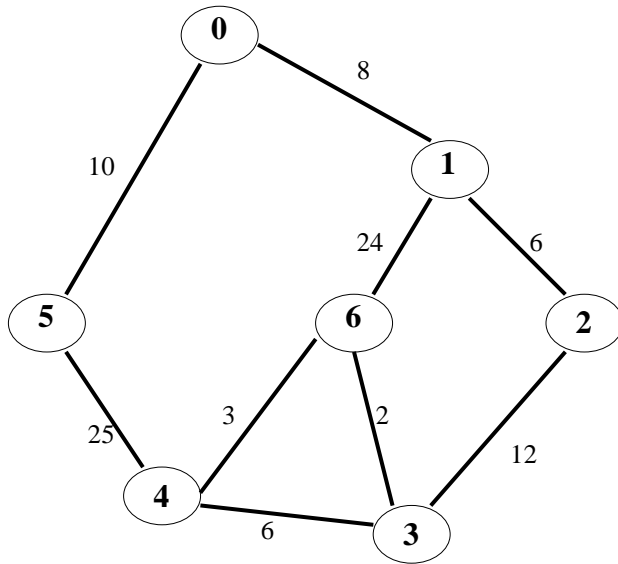


**(1) (15 pts)** Apply Dijkstra's Algorithm to find the shortest paths from vertex 4 to every other vertex of the following graph. Show all your work including the final Distance Vector!



**(2) (10 pts)** Describe the step-by-step process of UDP programming in Java.

**(3) (5 pts)** Briefly describe how CSMA/CA work.

**(4) (5 pts)** Differentiate slotted ALOHA from pure ALOHA. Describe why channel utilization efficiency is better in slotted ALOHA than that in pure ALOHA.

**(5) (8 pts)** What is the main argument against static channel allocations? Give two examples of static channel allocation.

**(6) (7 pts)** A new protocol similar to Ethernet is being proposed. Given that the maximum cable length is 2 km and the minimum frame size is 32 Kbits, calculate the allowable propagation delay (in nanosec/m) that is required by this protocol at a data rate of 10Mbps.

**(7) (10 pts)** Describe each of the following CSMA protocols: 1-persistent, non-persistent, and p-persistent. Which of these protocols provides the best throughput? Why?

**(8) (5 pts)** In the Basic Bit-map Protocol, the efficiency for low load is  $d/(N + d)$ , where  $d$  is the number of data bits and  $N$  is number of bit contention slots. Describe how the measure of efficiency came about, i.e. explain the meaning of the mathematical expression.

**(9) (5 pts)** Describe how the Adaptive Tree Walk protocol works.

**(10) (5 pts)** Describe the Binary Exponential Backoff algorithm.

**(11) (7 pts)** Describe why the transmission range of a **802.11b** signal is larger than that of **802.11a**. Describe why **802.11a** have a higher data rate than that of **802.11b**.

**(12) (8 pts)** Differentiate the two modes of 802.11 operations: Distributed Coordination Function (DCF) and Point Coordination Function (PCF).

**(13) (10 pts)** Describe each of the following 802.11 modulation techniques: FHSS, DSSS, OFDM.