Homework 3

1. Text problems beginning page 356 ed3: 4, 11, 15, 17, 21, 40

2. A datagram subnet allows routers to drop packets whenever they need to. The probability of a router discarding a packet is \( p \). Consider the case of a source host connected to a source router, which is connected to the destination router, and then to the destination host. If either of the routers discards a packet, the source host eventually times out and tries again. If both host-router and router-router lines are counted as hops, what is the mean number of
   a. Hops a packet makes per transmission?
   b. Transmissions a packet makes?
   c. Hops required per received packet?

4. Two CSMA/CD stations are each trying to transmit long (multiframe) files. After each frame is sent, they contend for the channel using the binary exponential backoff algorithm. What is the probability that the contention ends on round \( k \), for \( k = 1, 2, \ldots, 10 \). What is the mean number of rounds per contention period?

5. Consider the following design problem concerning implementation of virtual circuit service. If virtual circuits are used internal to the subnet, each data packet must have a 3-byte header, and each router must tie up 8 bytes of storage for circuit identification. If datagrams are used internally, 15-byte headers are needed, but no router table space is required. Transmission capacity costs 1 cent per \( 10^7 \) bytes, per hop. Router memory can be purchased for 1 cent per byte and is depreciated over two years (business hours only). The statistically average session runs for 1000 sec, in which time 200 packets are transmitted. The mean packet requires four hops. Which implementation is cheaper, and by how much?

6. A data link layer runs a sliding window protocol. A transmits using a sending window size of 6 and B receives using a receiving window size of 1. We assume that A always has traffic to send and that B sends Acknowledgements only. The channel delay is large enough that A transmits 6 frames before receiving any acknowledgements from B. A begins transmitting with sequence number 0 using a 3-bit sequence number. Suppose that the frame with sequence number 4 is lost once and no other errors occur. Write down (in order) the sequence numbers of all frames that A transmits until B successfully receives the 10th frame that it passes to the network layer.

7. A network on the Internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts it can handle?

8. Demonstrate the use of Dijkstra’s algorithm to compute the shortest path from A to D. Do this by building a table similar to the one I developed in class.

9. Based on the diagram below create routing tables for Routers 1, 2, 3, and 4. Make them complete enough so that each IP address shown in the diagram is reachable from all the other IP addresses shown, and use the fewest possible entries.