SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Spring 2017
ENSC 427: COMMUNICATION NETWORKS

Final Examination
Thursday, April 20, 2017

Duration: 180 minutes. Attempt all problems. Questions are not equally weighted. Closed book and closed notes.

Please provide detailed answers and include diagrams, graphs, and tables, as needed. Expand all acronyms. Simple calculators (with no graphing/programming functions) are permitted. PDAs, laptops, and wireless phones are not permitted. Please write legibly. Illegible text will not be graded. Please use a pen (no pencils, please).

1. **Peer-to-Peer Protocols and Data Link Layer (20 points)**

   (a) Describe the Selective Repeat ARQ protocols using the flowing sequence of events diagram. Include the case when one frame is lost. Clearly identify frame numbers and ACK/NACK numbers.

   (b) What is the maximum allowable size of the send window W_S and the receive window W_R for the $M = 2^m$ ($m = 2$) numbering sequence? Provide examples that clearly justify your answer.

   (c) Calculate the efficiency η_{SR} of the protocol if the probability of frame loss is P_f.

2. **Packet-Switching Networks (20 points)**: Consider two routing algorithms to find the shortest path between two nodes in a network. Assume that path from node i to a neighboring node j has distances D_j and cost C_{ij}. Write the pseudo-code to find the shortest path from source node s to all destination nodes d using:

   (a) Bellman-Ford algorithm

   (b) Dijkstra algorithm.

3. **TCP/IP (35 points)**:

   (a) Show the format of the TCP segment. Indicate its size and list the header fields.

   (b) Describe the TCP connection establishment. Use a digram to indicate sequence and ACK numbers.

   (c) Describe the TCP connection termination. Use a digram to indicate sequence and ACK numbers.

   (d) List four phases of the TPC congestion control algorithm. Indicate each phase on a plot of *TPC window size* vs. *time*.

(e) Describe two TCP mechansims to detects packet loss. How does TCP react in each case?

(f) What is the "round-trip time" and how is it estimated? Provide expressions and list all parameters and their values.

(g) What is "timeout"? How is its value set in TCP?

4. **Case study: Mining Network Traffic Data (25 points)**:

(a) What is Erlang B traffic model and where is it used? List the formula and identify all variables.

(b) Describe major properties of self-similar traffic. What is the Hurst parameter?

(c) List two statistical processes used to model traffic data collected from BCNET.

(d) Describe three families of graphs used to model network toplogies. What is currently a widely adopted model for the Internet topology?

(e) Briefly describe methodology used to classify Internet anomalies.