SIMON FRASER UNIVERSITY
SCHOOL OF ENGINEERING SCIENCE

Spring 2014
ENSC 427: COMMUNICATION NETWORKS
ENSC 894 SPECIAL TOPICS II: COMMUNICATION NETWORKS

Final Examination
Thursday, April 17, 2014

Duration: 180 minutes. Attempt all problems. Questions are not equally weighted.

Closed book and closed notes. Simple calculators (with no graphing/programming functions) are permitted. PDAs, laptops, and wireless phones are not permitted.

Please provide detailed answers and include diagrams, graphs, and tables, as needed. Expand all acronyms.

Please write legibly. Illegible text will not be graded. Use a ball-point pen for writing the examination (no pencils, please).

1. **Applications and Layered Architecture (9 points)**:
   (a) List the layers of the OSI and the layers of the data network reference models.
   (b) List the names of data units for each layer in the data network reference model.
   (c) Show layers present in the following network elements: server, client, and router.

2. **Digital Transmission Fundamentals (6 points)**:
   (a) Illustrate amplitude, frequency, and phase shift keying modulation techniques using the sequence 00110100010.
   (b) Explain the Nyquist signaling rate. Provide a simple example to justify your answer.

3. **Circuit Switching Networks (3 points)**
   (a) Write the Erlang B formula. Explain all variables.

4. **Peer-to-Peer Protocols and Data Link Layer (6 points)**:
   (a) Describe the Stop and Wait ARQ protocol using the flowing sequence of events diagram. Include the case when one frame is lost. Clearly identify the frame numbers and ACK numbers.
   (b) What is the time to send a frame and receive an ACK in the absence of errors? Show the diagram explaining each term in the expression.

5. **Medium Access Control Protocols and Local Area Networks (6 points)**:
   (a) What is CSMA/CD? Briefly describe the algorithm.
   (b) List and briefly describe the three CSMA back-off mechanisms.

6. **Packet-Switching Networks (25 points)**:
   (a) List two main families of routing algorithms. List an example for each family.
   (b) Describe the Bellman-Ford algorithm using Fig. 1. Show each step of the algorithm using a table. Draw shortest path tree found by the algorithm.
   (c) What is the counting to infinity problem in routing? Show a simple example to illustrate the problem.
   (d) Describe two remedies: Split Horizon and Poisoned Reverse.

7. **TCP/IP (20 points)**:
   (a) What is an Autonomous System (AS)?
   (b) What is the Interior Gateway Protocol (IGP)? Where is it used? List two well known IGPs.
   (c) What is the Exterior Gateway Protocol (EGP)? Where is it used? List the well known EGP example.
   (d) List two main IPv6 features. What is the mechanism used to route IPv6 packets through a network with IPv4 routers?

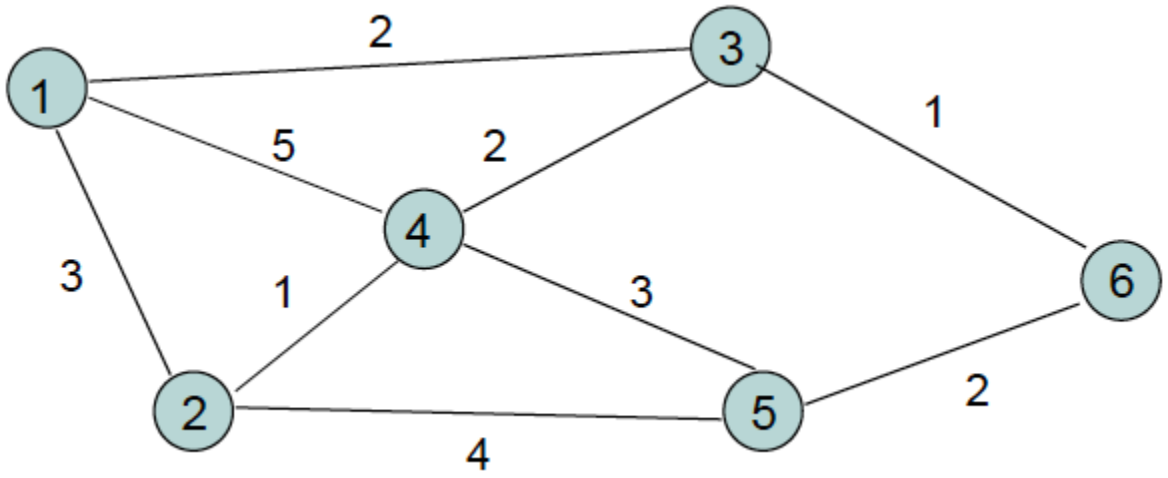

Figure 1: A network with associated link cost.

8. **TCP/IP (25 points)**:

   (a) List all steps of the TCP connection establishment. Include all messages and sequence numbers. State the common name of this process.

   (b) List all steps of the TCP connection closing. Include all messages and sequence numbers. State the common name of this process.

   (c) What is the value of the initial window size? How is the initial sequence number selected?

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

   (e) What are the two mechanisms used by TCP to detect packet loss? How does TCP react in each case?