

Professional Engineers of Ontario

December 2011

07-Elec-B4
Information Technology Networks

3 Hours Duration

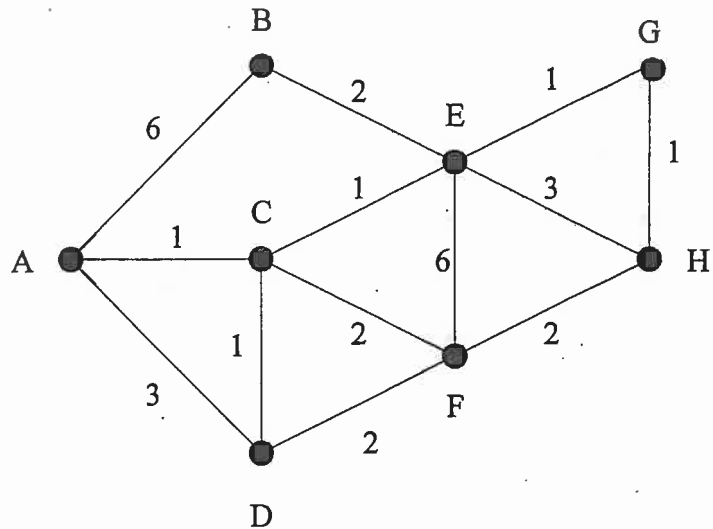
Notes:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumptions made.
2. This is a closed book exam. A Casio or Sharp approved calculator is permitted.
3. There are **5 questions** on this exam. **Any 4 questions constitute a complete paper.** If you attempt more than 4 questions, clearly indicate which ones are to be graded; otherwise, only the first 4 questions as they appear in your answer book will be marked.
4. Marks allocated to each question are noted in the left margin. A complete paper is worth 100 marks.

25 marks

Question 1. This question concerns minimum-cost routing.

Use Dijkstra's algorithm to find the minimum-cost routes from node A to every other node in the network. For full marks, show all work.



25 marks

Question 2. This question concerns cellular telephony.

5 marks

a. Explain, giving an example, why dividing space into “cells” increases the number of users who can simultaneously use a given wireless bandwidth.

5 marks

b. Modern cellular systems, such as 3GPP LTE, use OFDM to transmit data. Briefly describe this method and its features.

5 marks

c. Briefly explain how the available bandwidth is shared among users in a GSM system.

5 marks

d. Suppose a cellular system has 50 MHz of bandwidth available, and FDMA is used to share the bandwidth, where each user is allocated 40 kHz. In a system with 143 cells, with a cluster size of 13, how many simultaneous users can the system accommodate?

5 marks

e. Suppose a particular small location in a cellular system has unusually heavy demand. How could a system designer accommodate this demand?

25 marks **Question 3.** This question concerns the transport layer.

- 6 marks a. TCP and UDP are the two most prominent transport layer protocols in use. Briefly explain the major differences between these protocols.
- 4 marks b. Give an example of an application that is better for TCP, and one that is better for UDP.
- 9 marks c. Using TCP, suppose the initial window size is 1, and the congestion threshold is 16. Assuming all packets are acknowledged, give an example showing how the window size evolves up to and beyond the threshold.
- 6 marks d. Considering the same setup as in part b, suppose the a packet in the third window is not acknowledged. Give the congestion window sizes for the first eight TCP windows.

25 marks **Question 4.** This question concerns layered architecture.

- 15 marks a. Name, and describe in one sentence, each layer of the OSI seven-layer model.
- 10 marks b. Of these layers, name the layer where the following are found.
- i. Error control coding.
 - ii. Flow control.
 - iii. The HTTP protocol.
 - iv. Routing.
 - v. Signal voltages.

25 marks **Question 5.** This question concerns medium access control protocols.

- 9 marks a. In wireless networks, explain the hidden terminal problem and the exposed terminal problem. Explain how RTS-CTS methods can mitigate both problems.
- 5 marks b. Briefly discuss the operation of CSMA/CD in Ethernet, making specific reference to collisions, and recovery from collisions.
- 5 marks c. Briefly explain the operation of a token-ring network. Are collisions possible in token ring? Explain.
- 6 marks d. Using any medium access control scheme, what is the shortest period of time that could pass before a collision is detected? Explain.