Professional Engineers of Ontario

Annual Examinations – May 2013

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 PEO-approved non-programmable calculator is permitted.
3. There are **5 questions** on this exam. **Any 4 questions constitute a complete paper.** 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 the Internet Protocol (IP), versions 4 and 6.

(7 marks) a. Consider the following IPv4 routing table.

Destination	Mask	Next Hop
127.0.0.1	255.255.255.255	127.0.0.1
129.96.0.0	255.255.255.0	129.96.54.1
129.97.152.0	255.255.255.128	129.97.152.1
129.97.152.128	255.255.255.128	129.97.152.183
default	0.0.0.0	129.97.0.1

Identify the next hop for the following IP address destinations:
  i. 129.96.56.254
  ii. 129.97.152.129
  iii. 129.128.0.1
  iv. 129.97.152.1
  v. 129.96.0.178

(5 marks) b. Some IP ranges are reserved for private networks. Give any two reserved ranges, in either IPv4 or IPv6.

(8 marks) c. Briefly describe a system that might have the above routing table. Use a diagram if you wish.

(5 marks) d. Give three advantages of IPv6 over IPv4.

(25 marks) **Question 2.** This question concerns transport layer protocols.

**(5 marks)** a. Briefly discuss the differences between TCP and UDP.

(5 marks) b. Using an example, illustrate why end-to-end congestion control is necessary in large wired networks.

(7 marks) c. Using TCP, suppose the initial window size is 1, and the congestion threshold is 32. Assuming all packets are acknowledged, give an example showing how the window size evolves up to and beyond the threshold.

(8 marks) d. Repeat part b, assuming a packet in the fourth window is not acknowledged, and TCP enters slow start. In your example, illustrate all relevant features of TCP.

(25 marks)   Question 3. This question concerns shortest-path routing.

Apply Dijkstra's algorithm to find the paths from node B to all other nodes in the following network, with the given edge distances. Show all work; credit will not be awarded unless Dijkstra's algorithm is correctly followed.
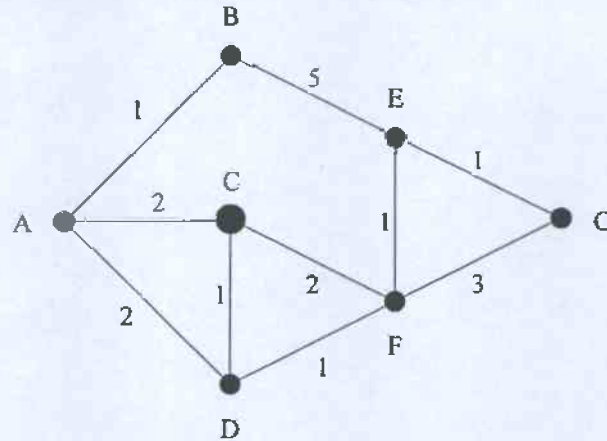
(25 marks)   Question 4. This question concerns layered architecture.

(5 marks)   a. What is the advantage of using a layered architecture when designing networks?

(10 marks)   b. Name each layer of the OSI seven-layer model, and describe it in one sentence.

(10 marks)   c. Of the seven layers in the OSI model, name the layer (or layers, if more than one) where each of the following is used or found.

        i.   Ethernet.
        ii.   The SMTP protocol.
        iii. Carrier frequency for a wireless signal.
        iv.   Confirmation of end-to-end packet delivery across multiple hops.
        v.   The HTTP protocol.
        vi.   Error-control coding.
        vii. Routing.
        viii. The TCP/IP protocols.

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

(5 marks)   a.   Briefly discuss the operation of CSMA/CD, making specific reference to collisions, and recovery from collisions.

(5 marks)   b.   How does a token ring network operate differently from CSMA/CD? Are collisions possible in token ring?

(10 marks)   c.   In a wireless network, briefly explain the hidden terminal problem, and the exposed terminal problem. Explain how RTS-CTS-ACK control messages solve these problems.

(5 marks)   d.   Using any medium access control scheme, what is the shortest period of time that could pass before a collision is detected? Explain.

(20 marks)   6.   This question concerns the data link layer and peer-to-peer protocols.

(5 marks)   a. Briefly describe how cyclic redundancy checks (CRCs) detect whether a packet contains an error, making specific reference to CRC encoding with generator polynomials.

(5 marks)   b. For a CRC system, let the generator polynomial be $g(x) = x^2+1$. If the information polynomial is $i(x) = x^5$, give the output of the CRC encoder.

(8 marks)   c. Briefly describe the operation of ARQ, specifically describing stop-and-wait ARQ as well as go-back-n ARQ.

(2 marks)   d. If propagation delay is large with respect to the packet size, which is more efficient: stop-and-wait ARQ or go-back-n ARQ? Explain.