

# Professional Engineers of Ontario

Annual Examinations – Dec 2010

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.** Only the first 5 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)

1. This question concerns medium access control protocols.

(6 marks)

a. Briefly discuss the operation of ALOHA, making specific reference to the protocol's behavior as a result of collisions.

(8 marks)

b. Briefly discuss the operation of CSMA/CD in Ethernet, making specific reference to collisions, and recovery from collisions.

(8 marks)

c. Briefly explain the operation of a token-ring network. Give two allowed token-reinsertion strategies and discuss their effects on network performance.

(3 marks)

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

(25 marks)

2. This question concerns IP packet routing.

(12 marks)

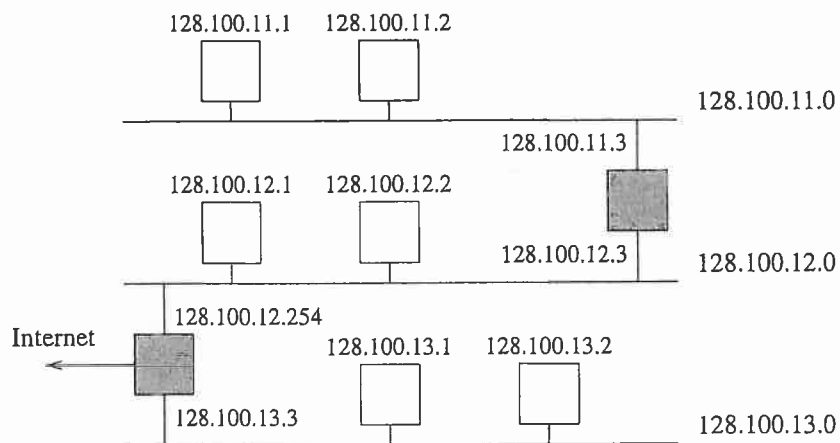
a. Consider the network of LANs in the diagram below. Dark squares are routers, and light squares are hosts. Give the IP routing table at the router bridging the 128.100.11.0 and 128.100.12.0 networks.

(8 marks)

b. Give, and explain, the path through the network for a packet originating at 128.100.13.2 with destination 128.100.11.1.

(5 marks)

c. What IP address would node 128.100.11.2 have as its gateway?



(25 marks)

3. This question concerns transport layer protocols.

(7 marks)

a. TCP and UDP are the two most prominent transport layer protocols in use. Briefly explain the major differences between these protocols.

(9 marks)

b. 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.

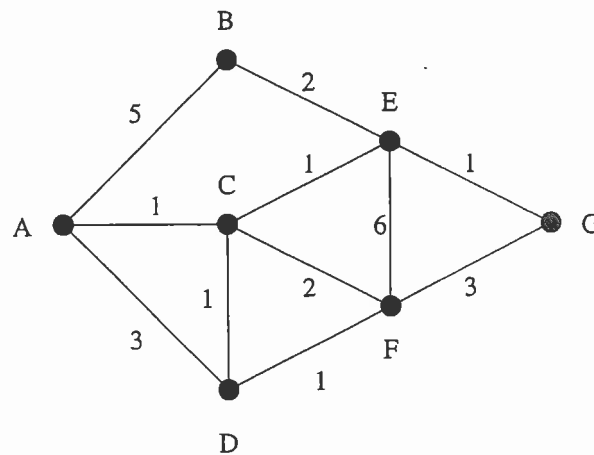
(9 marks)

c. Considering the same setup as in part b, suppose the a packet in the fourth window is not acknowledged. Give the congestion window sizes for the first eight TCP windows.

(25 marks)

4. This question considers optimal routing in packet-switched networks.

Using Dijkstra's algorithm, find the shortest paths from node A to all other nodes in the network. Show all work.



- (25 marks) 5. This question concerns cellular telephony.
- (5 marks) a. The GSM system uses TDM to transmit data. Eight users share a TDM frame of duration 4.615 milliseconds (ms), where each user transmits a 148-bit data frame. There is a guard time of 0.030 ms. What is the peak bit rate of the system, and what is the net bit rate per user?
- (10 marks) b. Some implementations of LTE technology include orthogonal frequency division multiplexing (OFDM) and multiple-input, multiple-output (MIMO) transmission. Explain both terms.
- (5 marks) c. Consider a cellular system with total available bandwidth of 28 MHz. If the system contains 49 cells, and if the frequency reuse cluster size is 7, how much bandwidth is allocated to each cell?
- (5 marks) d. For the same system as in part c, say FDMA is used, and each user requires 40 kHz. How many users can be accommodated in the entire system?