Professional Engineers of Ontario

Annual Examinations – May 2016

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, unless you **clearly** indicate which questions you want marked **on the front of your exam booklet**.
4. Marks allocated to each question are noted in the left margin. A complete paper is worth 100 marks.

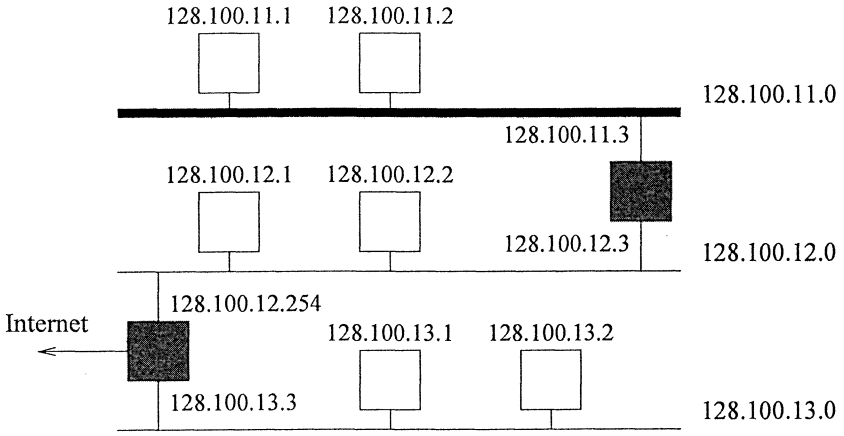
(25 marks) **Question 1.** This question concerns IP packet routing.

(5 marks) a. How many possible IP addresses are there in IPv4? (Ignore any reserved or special addresses and give the total possible number.) Briefly explain "address space exhaustion", and give one possible solution.

(10 marks) b. Consider the network of LANs in the diagram below. Dark squares are routers, and light squares are hosts. Give the IP routing tables at both routers, including netmasks and gateways.

(5 marks) c. Give, and explain, the path through the network for a packet originating at 128.100.11.2 with destination 128.100.13.1.

(5 marks) d. Your company needs an IP address. A salesman offers to sell the IP address 127.0.0.1 to your company. Do you buy the address? Explain.



(25 marks) **Question 2.** This question concerns layered architecture.

(10 marks) a. Name each layer of the OSI seven-layer model, and describe it in one sentence. (Be brief; marks may be deducted for unnecessary detail!)

(10 marks) b. 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. The UDP protocol.
ii. The SMTP protocol.
iii. Routing.
iv. Ethernet.
v. Successful packet delivery across a single link.
vi. Encryption and decryption.
vii. Character display, such as ASCII.
viii. Signal voltages.

(5 marks) c. When might layered design be a *disadvantage*?

(25 marks) **Question 3.** This question concerns medium access control protocols.

(5 marks) a. In wireless networks, explain the hidden terminal problem. Explain how RTS-CTS methods can mitigate this problem.

(5 marks) b. In wireless networks, explain the exposed terminal problem. Explain how RTS-CTS methods can mitigate this problem.

(5 marks) c. Briefly explain the operation of a token-ring network. Are collisions possible in token ring? Explain.

(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.

(5 marks) e. Why is an Aloha protocol appropriate than CSMA/CD for schemes where propagation time is very long, e.g. in satellite communication?

(25 marks) **Question 4**. This question concerns the WiFi and Bluetooth wireless protocols.

(5 marks) a. Briefly describe the structure of a Bluetooth piconet, including Master, Slave, and Parked devices. How many of each type of device are allowed?

(10 marks) b. Frequency hopping spread spectrum is used to share the medium among devices in a Bluetooth piconet. Explain how this works.

(5 marks) c. In a WiFi network, what services are provided by each of Basic Service Set (BSS) and Extended Service Set (ESS)?

(5 marks) d. Briefly describe medium access sharing in WiFi, making specific reference to inter-frame spacing.

(25 marks) **Question 5.** This question concerns transport layer protocols.

(5 marks) a. Suppose you have a video streaming application over an unreliable link. Would you use TCP or UDP? Briefly explain your choice.

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

(7 marks) c. Using TCP, suppose the initial window size is 1, and the congestion threshold is 64. 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.

Marking Scheme

1. 25 marks
    a. 5 marks
    b. 10 marks
    c. 5 marks
    d. 5 marks
2. 25 marks
    a. 10 marks
    b. 10 marks
    c. 5 marks
3. 25 marks
    a. 5 marks
    b. 5 marks
    c. 5 marks
    d. 5 marks
    e. 5 marks
4. 25 marks
    a. 5 marks
    b. 10 marks
    c. 5 marks
    d. 5 marks
5. 25 marks
    a. 5 marks
    b. 5 marks
    c. 7 marks
    d. 8 marks