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UNIVERSITI SAINS MALAYSIA

Semester II Examination  
Academic Session 2012/2013

June 2013

**EEE 521 – Computer And Data Communications Networks**

Duration : 3 Hours

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INSTRUCTION TO CANDIDATE:

Please ensure that this examination paper contains SEVEN printed pages and SIX questions before answering.

Answer FIVE questions.

Answer to any question must start on a new page.

Distribution of marks for each question is stated accordingly.

All questions must be answered in English.

1. (a) Mr. John living in London wants to communicate with Mr. Lee living in Beijing using a digital circuit-switched network. The path in the circuit-switched network has a data rate of 10 Mbps. The exchange of 1000 bits is required for the setup and teardown phases. The distance between London and Beijing is approximately 8000 km. Let's assume the propagation speed of the signal to be  $2 \times 10^8$  m/s. What is the total delay if
- (i) 1000 bits of data are exchanged during the data transfer phase?
  - (ii) 100,000 bits of data are exchanged during the data transfer phase?
  - (iii) 1,000,000 bits of data are exchanged during the data transfer phase?
  - (iv) Find the delay per 1000 bits of data for each of the above cases and compare them. What can you infer?

(45 marks)

- (b) Five equal size datagrams belonging to the same message leave for the destination one after another. However, the datagrams travel through different paths as shown in Table 1. Let's assume that the delay for each switch (including waiting and processing delay) is 6 ms, 9 ms, 15 ms, 11 ms, and 15 ms respectively. Also, assume the propagation speed of the signal to be  $2 \times 10^8$  m/s. Find the order in which the five datagrams will reach the destination and the delay for each individual datagram.

(30 marks)

Table 1

Datagram	Path length	Visited switches
1	8000 km	2, 4, 5
2	4900 km	1, 2, 4
3	7300 km	2, 3, 5
4	5770 km	1, 2, 3, 4
5	6400 km	2, 3, 4, 5

- (c) Compare the performance of circuit-switched and packet-switched networks in terms of bandwidth efficiency and delay.

(25 marks)

2. (a) Show how the sequence 10110111 will be encoded using the following line coding techniques:

- (i) Polar RZ
- (ii) Manchester
- (iii) Differential Manchester
- (iv) AMI

(40 marks)

- (b) What is the result of scrambling the sequence 1111000000000000 using the following scrambling techniques? Assume that the last non-zero signal level has been negative.

- (i) B8ZS
- (ii) HDB3 (The number of non-zero pulses is even after the last substitution)

(30 marks)

- (c) 100 digitized voice channels need to be transmitted over a band-pass channel occupying the frequency range from 150 kHz to 200 kHz. There must be a guard band of 100 Hz between two adjacent channels to prevent interference. Determine the spectral efficiency (bits/Hz) required for this system. Assume that a voice channel occupies a bandwidth of 4 kHz.

(30 marks)

3. (a) In a cyclic redundancy check (CRC) error detection technique, the dataword to be sent is 1101011 and the divisor used is 11001.

- (i) Show the generation of CRC codeword at the sender side (use binary division).
- (ii) If the generated codeword arrives at the receiver without damage, show how the receiver will determine that no error has occurred during the transmission?
- (iii) If the received codeword is 11000001010, show how the receiver will determine that an error has occurred during the transmission?

(50 marks)

(b) Draw the flow-diagram for Stop-and-Wait ARQ protocol for the following scenario:

- (i) The first frame is sent and acknowledged.
- (ii) The second frame is sent but lost.
- (iii) The second frame is resent and acknowledged, but the acknowledgement is lost.
- (iv) The second frame is resent and successfully acknowledged.

(30 marks)

(c) Byte-stuff the following frame payload in which *E* is the escape byte, *F* is the flag byte, and *D* is the data byte.

<i>D</i>	<i>E</i>	<i>E</i>	<i>D</i>	<i>F</i>	<i>D</i>	<i>F</i>	<i>E</i>	<i>F</i>	<i>F</i>	<i>D</i>	<i>D</i>
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(10 marks)

- (d) Unstuff the following frame payload:

011011111011111011111010010

The 8-bit pattern flag used for bit-oriented framing is 01111110.

(10 marks)

4. (a) A network uses pure ALOHA protocol to transmit 200-bit frames on a shared channel of 100 kbps. What is the throughput if the system (all stations together) produces

- (i) 500 frames per second
- (ii) 250 frames per second
- (iii) 125 frames per second

(30 marks)

- (b) If the network in part (a) uses slotted ALOHA protocol instead of pure ALOHA, determine the throughput for all the cases in part (a). Compare the performances (in terms of throughput) of two protocols and discuss the reason behind the difference.

(25 marks)

- (c) Briefly discuss the behavior of three persistence methods i.e. 1-persistent, non-persistent and  $p$ -persistent methods used in CSMA protocol. Which method amongst the three has the lowest throughput and why?

(35 marks)

- (d) Explain why collision is an issue in random-access protocols but not in controlled-access protocols?

(10 marks)

5. (a) Use Bellman-Ford algorithm to find the most cost-effective routes from node A to all the other nodes in Figure 1. Also, determine the cost of each of these routes. (50 marks)

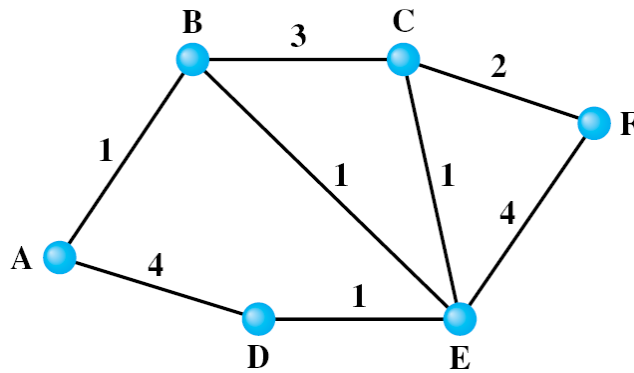


Figure 1

- (b) Use Dijkstra algorithm to find the most cost-effective routes from node A to all the other nodes in Figure 2. Also, determine the cost of each of these routes. (50 marks)

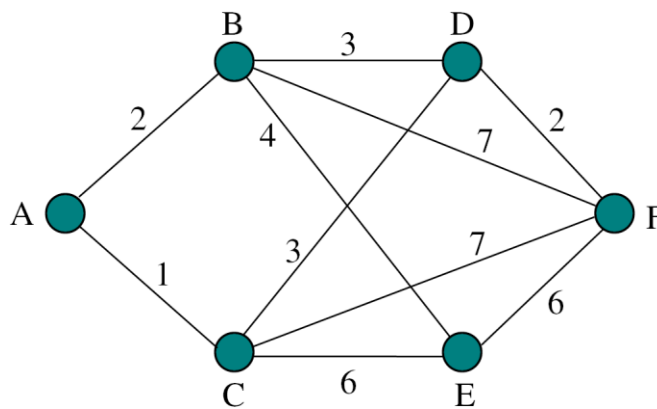


Figure 2

6. (a) Design a Go-Back- $N$  (GBN) sliding window protocol for a network in which the bandwidth is 50 Mbps and the average distance between the sender and receiver is 8,000 km. Assume the average packet size to be 10,000 bits and the propagation speed of the signal as  $2 \times 10^8$  m/s.
- (i) Find the maximum size of the send and receive windows
  - (ii) The number of bits in the sequence number field ( $m$ )
  - (iii) Appropriate time-out value for the timer
- (35 marks)
- (b) Assume a sender sends 6 packets with sequence numbers 0, 1, 2, 3, 4 and 5. The sender receives an acknowledgement (ACK) with AckNo = 3. What is the interpretation if the system is using (i) Go-Back- $N$  (GBN) protocol (ii) Selective-Repeat (SR) protocol?
- (20 marks)
- (c) Using an 8-bit sequence number, what is the maximum size of the send and receive windows for each of the following protocols?
- (i) Stop-and-Wait
  - (ii) Go-Back- $N$  (GBN)
  - (iii) Selective-Repeat (SR)
- (20 marks)
- (d) What are the differences between connection-oriented and connectionless services provided by the transport layer? Give examples of protocols which provide connection-oriented or connectionless services.
- (25 marks)

