00153

The Open University of Sri Lanka
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

ECX5234 Data Communications
FINAL EXAMINATION – 2010/2011 (CLOSED BOOK)

DATE: 11th March 2011 **0930 hrs – 1230 hrs**

Answer 5 questions. All question carry equal marks.

Q1. (a) Give 2 advantages and 2 disadvantages of using layered network architecture. *[04]*

(b) Match the following functions to one or more layers of the OSI model.

(i) Flow control
(ii) Route determination
(iii) Log-in and log-out procedures
(iv) Providing user services such as e-mail and file transfer
(v) Encapsulation *[05]*

(c) Both Nyquist and Shannon Theorems place an upper limit on the bit rate of a channel based on 2 different approaches. Define the Nyquist and the Shannon limits on channel capacity and briefly describe how they are interrelated. *[05]*

(d) Suppose the frequency spectrum of a communication channel is from 3MHz to 4MHz.
(i) If the signal to noise ratio of the channel is 24 dB, find the capacity of the channel.
(ii) If there were no noise, how many signal levels would be needed to achieve the above bit rate? *[06]*

Q2. (a) Compare Circuit switching, datagram packet switching and virtual circuit packet switching in terms of the following:

(i) requirement of a dedicated path
(ii) requirement of connection set-up
(iii) overhead bits
(iv) bandwidth usage
(v) delay *[10]*

(b) Explain the impact of packet size in packet switching. *[02]*

(c) For the bit pattern 1000110111, draw the encoded output of the following line encoding schemes

(i) NRZ-I
(ii) Manchester
(iii) Differential Manchester *[06]*

(d) What are the advantages of using Manchester encoding compared with binary encoding? *[02]*

Q3. (a) If the average bit error rate is 1 in 10^5, what is the probability of having
(i) single bit error
(ii) single bit correct
(iii) at least one error in a byte ?
[06]

(b) In CRC, show the relationship between the following entities. (Size means the number of bits.)
(i) The size of the dataword and the size of the codeword
(ii) The size of the divisor and the remainder
(iii) The degree of the polynomial generator and the size of the divisor *[06]*

(c) A data bit stream of 10011111 is transmitted using the CRC method with the generator polynomial x^3+x+1.
(i) Draw the shift register implementation of the transmitter.
(ii) Find the actual bit string transmitted.
(iii) Suppose the 3rd bit from the left is inverted during transmission. Show whether this error can be detected at the receiver's end.
(iv) Briefly discuss the capability of finding out different types of errors using the CRC method.
[08]

Q4. (a) Briefly describe the most significant differences of IPv6 compared to IPv4 addressing.
[05]

(b) An ISP is granted a block of addresses starting with 190.100.0.0/16. The ISP wants to distribute these addresses to three groups of customers as follows:
- The first group has 64 customers; each needs 256 addresses.
- The second group has 128 customers; each needs 128 addresses.
- The third group has 120 customers; each needs 64 addresses.

(i) Design the sub-blocks and give the slash notation for each sub block. (Present your answer by giving IP ranges of the first two customers and the last two customers of each group.)
(ii) Find out
A. number of addresses granted to ISP
B. total number of addresses allocated by the ISP
C. number of addresses still available after these allocations. *[15]*

Q5. (a) The Medium Access Control (MAC) in the 802.11 specification supports an optional access method designed to avoid the hidden terminal problem.
(i) What is the hidden terminal problem that occurs in 802.11 networks?
(ii) Briefly explain the MAC protocol used in 802.11 networks and how it avoids the hidden station problem.
(iii) Compare this MAC protocol with the MAC protocols used in wired Ethernet.
[10]

(b) Consider CSMA/CD protocol. Find the minimum frame length for a 1Mbps bit rate and maximum network span of 10 km with no repeaters. Assume the propagation delay of the medium is 4.5 nanoseconds per meter. *[05]*

(c) Briefly explain what is meant by MAC address of a computer and its significance in a local area network. *[05]*

Q6. (a) The purpose of a routing algorithm is to find the least cost paths from source to destination. Explain 2 possible cost metrics used in these algorithms. *[04]*

(b) Define fixed routing and adaptive routing used in packet switching networks. Give 2 advantages and 2 disadvantages of adaptive routing over fixed routing. *[04]*

(c) Give the main difference between Distance vector routing and Link State routing. *[02]*

(d) Consider the network with link costs shown in figure Q6 below. Use the Distance Vector approach to show the distance vectors at node A.
Hence determine the shortest path from A to F. *[10]*

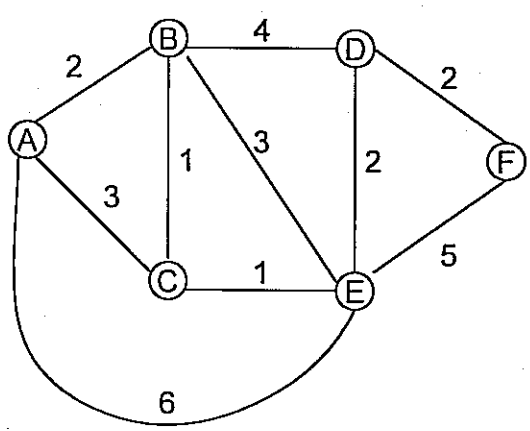

Figure Q6

Q7. (a) Explain the principle behind the following:

(i) DHCP
(ii) NAT
(iii) VLAN
(iv) MPLS-VPN *[08]*

(b) Suppose that a user is browsing the web and finds a link on internet telephony that points to ITU's home page, which is http://www.itu.org/home/index.html. List the steps that occur in relation to the Application, Transport and Network layers. *[07]*

(c) What do you understand by the term "Reverse Address Resolution"? Why is it important for today's internet? *[05]*

Q8. (a) Sketch the timing diagram for a Stop and Wait ARQ system showing both error free and data packet loss cases. Mark all the required parameters in the same diagram. *[04]*

(b) Identify all the delay components of Stop and Wait ARQ and clearly mark them on the diagrams in part (a). *[04]*

(c) Briefly explain the main drawback of Stop and Wait protocol and how it can be overcome using Go-Back-N protocol. *[02]*

(d) Consider a bidirectional link between A and B that uses Go-Back-N protocol with N=7. Suppose that transmission time for each data frame is one unit long and they use a timeout value of 3 units. Assume the propagation time is 0.5 unit and the processing time is negligible. The acknowledgment timer is one unit long. Assuming that A and B begin with their sequence numbers set to zero, use timing diagrams to show the pattern of transmissions for the following sequence of events.

(i) Station A sends 6 frames in a row, starting at t=0. All frames are received correctly.
(ii) Station A sends 6 frames in a row, starting at t=0. Frame 3 is lost and all other frames are received correctly. *[10]*