The Open University of Sri Lanka
Department of Electrical & Computer Engineering
ECX5234 Data Communications
FINAL EXAMINATION– 2013/2014 (CLOSED BOOK)

DATE: 15th August 2014 **0930 hrs – 1230 hrs**

Answer any 5 questions.

Q1. (a) Briefly explain the main function of each layer in OSI layered model and give a protocol for each. [07]

(b) Briefly describe the relationship between the following:
(i) Bit rate and baud rate
(ii) Sampling rate and signal frequency spectrum
(iii) Pulse code modulation and delta modulation [06]

(c) Suppose that you are required to transmit a digital music signal sampled at a rate of 44100 samples per second and with each sample represented as a 16-bit word.
(i) Calculate the channel bit rate.
(ii) What is the bandwidth of the signal?
(iii) If this signal is to be transmitted in a noisy channel with a SNR of 30 dB, calculate the number of levels needed to maintain the same channel bit rate as in (c)(i). [07]

Q2. (a) Draw the encoded bit pattern of the data sequence 010100011101101 for the following coding schemes:
(i) Polar RZ
(ii) Manchester
(iii) Differential Manchester
(iv) MLT-3 [08]

(b) A link has a bit error rate of 10^{-9}. If bit errors are independent of each, what is the probability that a file with 1 million bits will be transferred over the link without errors? [03]

(c) Consider transmitting a 15-bit data stream 010110011111101. Compute the parity bits that would form the error correction code if 5x3 two-dimensional parity scheme is used. [04]

(d) Two computers exchange messages over a link and agree to use a CRC with generator x^3+1 to detect errors. One computer wishes to send the message 100111001100. What remainder should it append the message for transmission? [05]

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Q3. (a) Differentiate the following:

(i) ALOHA and Slotted ALOHA

(ii) CSMA/CD and CSMA/CA

(iii) MAC address and Network address [06]

(b) Consider a CSMA/CD network has a data rate of 10Mbps. The maximum end to end propagation time is 25.6μs and the propagation speed of the medium is 2×10^8 m/sec.

(i) Find the minimum frame size and the maximum segment length for the correct operation of the collision detection process.

(ii) If the data rate increases to 100Mbps, how long can the frame be so that a node will be sure that it will detect a collision? [07]

(c) Consider an email message being sent from a host to another host on the Internet.

(i) What transport and application layer protocols could be required in this message delivery?

(ii) Identify all such transactions that will take place for the purpose of this email delivery. [07]

Q4. (a) Explain the Little's theorem related to a queuing system. [03]

(b) A DNS server receives 10 requests per second. All requests and services are exponentially distributed. If the average service time is 20 ms, answer the following questions.

i. Give Kendall's notation for this queuing system.
ii. Calculate the utilization of the server.
iii. What is the average time each request spends in the queue?
iv. What is the number of requests waiting in the queue?
v. Calculate the average response time a request spends in the system?
vi. What is the number of requests waiting in the system? [14]

(c) Explain the operation of the DNS Server if utilization is greater than 1. [03]

Q5. (a) Compare the 3 ARQ techniques Stop & Wait, Go-back-N and Selective repeat according to their efficiency in a noisy channel. Justify your answer by describing their operation with a suitable example. [06]

(b) Frames of 1000 bits are sent over a 1 Mbps satellite channel. The distance between the sender and the receiver is 5000 km and the propagation speed is 2×10^8 m/sec. How long does it take to send 1 million bits of data file? Assume that queuing and processing delays are negligible and no data or control frame is lost. [06]

(c) If the above system in (b) uses Go-back-N ARQ protocol with a window size of 7, calculate the time taken to send the 1 million bits data file. You can ignore the overhead due to the header and trailer. [08]

Q6. (a) Briefly explain a technique to increase the utilization of address space when assigning IP addresses. [03]

(b) The MechNet Company has four locations: a head office and three branch offices. Each of the branches is connected to the head office by a point-to-point link. The branches have one or more LANs connected to their routers.

Head office has a single LAN which connects 300 users.
Branch 1 has 2 LAN s with 100 users each.
Branch 2 has 3 LANs with 50 users each.
Branch 3 has 2 LANs with one has 275 users and the other has 105 users.

The company has been assigned the 172.16.0.0/21 address space to work with. Your task is to design a complete IP addressing plan which provides the maximum utilization of IP address space. For each sub network provide the network address, broadcast address, subnet mask and the range of host addresses. [14]

(c) List 3 transition strategies used to transfer from IPv4 to IPv6. [03]

Q7. (a)(i) Many people get high speed internet access through ADSL technology. It converts the regular phone line into a high-speed digital link, enabling simultaneous transmission of voice and data, as opposed to dial-up internet. Explain how ADSL ensures that both data and telephone calls can be carried over the same twisted pair cable which connects a house to a local exchange? [03]

(ii) In ADSL, the download and upload speeds are different. Explain how this is achieved. [04]

(b)(i) Explain the difference between VLAN (Virtual Local Area Network) and VPN (Virtual Private Network) by giving an example for each. [06]

(ii) Can the devices in two VLANs communicate with each other? Explain. [03]

(iii) Explain the difference between Ethernet in LAN and Metro Ethernet Network. [04]

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Q8. (a) A company uses NAT (Network Address Translation) to connect multiple workstations (WS) to the internet using a single IP address (203.45.103.67) provided by its ISP. Show how packets sent from a specific workstation WS (10.23.52.205) to another workstation (125.25.43.84) are handled by the NAT. [05]

(b) (i) Flooding is usually used for broadcasting information in the network shown in figure Q8. Show the flow of packet P from B to F. (Show all flows due to P from B). [05]

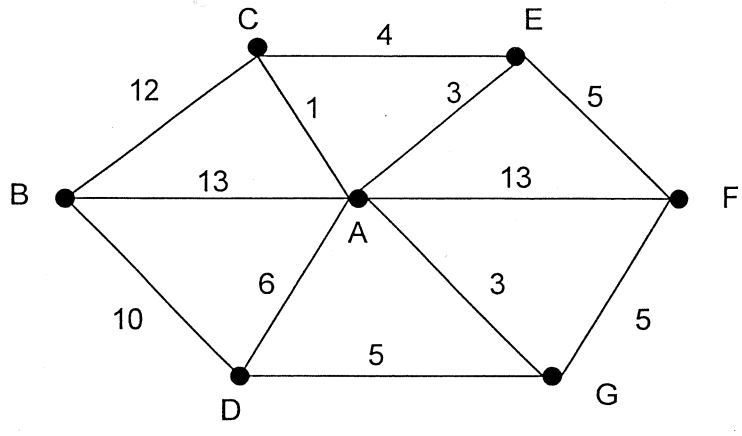

Figure Q8

(ii) Use Distance vector routing protocol to determine the shortest path from B to all other nodes of the above network.

[10]