The Open University of Sri Lanka
ECX5234 Data Communications
FINAL EXAMINATION– 2006/2007 (CLOSED BOOK)

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DATE: 19th April 2007 **0930 hrs – 1230 hrs**

Answer ***Question 1*** and ***4 others.*** All questions carry equal marks.

1. A new learning resource center is being established at a University and requires a network to be designed to link together various IT facilities. The new center comprises two floors: one floor split into two open plan areas and a common area where users can bring their laptops to work in a calm and quiet environment , the other floor is split into 20 individual offices. The open plan areas are to house 30 and 50 PCs respectively and each office is to be equipped with a single PC. The interior designer of the building has issued strict instructions not to allow any cable visibility in the common area.

   This center needs to be linked to the University data center located close to the building. The data center houses all the important servers of the university.

   A link is also required to connect the learning resource center's network to an affiliated college network, which is 1 km away and is right across a major highway.

   (i) Design the overall topology of the network (You should provide a sketch of your design indicating where items such as switches, bridges etc., might be used) [8]

   (ii) Recommend the optimum choice for the inter-site link (justify your recommendation considering the possible problems that might arise in connecting these two places.) [4]

   (iii) Describe the type of media that will be used for connectivity at different places of the network with proper justification for selection of such media. [5]

   (iv) Comment on the implications of your network design for future expansion. [3]

2. (a) Explain the significance of Layer to Layer Interfaces in the OSI Layered hierarchy. [3]

   (b) Clearly explain the basis for determining the Minimum Frame Size in Ethernet. [4]

   (c) Clearly explain why Data Link Layer is divided into two separate layers in IEEE 802 local area network standards: Logical Link Control (LLC) and Medium Access Control (MAC). [4]

(d) Local Area Networks (LANs) and Wide Area Networks (WANs) generally use different topologies. Clearly explain the reasoning behind the choice of topology for LANs and WANs listing out the features suited for each. [5]

(e) Ethernet is based on CSMA/CD and collisions are an integral part of the protocol. Clearly explain the following statement.
"Collision domain of a Network Hub is all ports of the hub whereas Collision domain of Network Switch is a single port". [4]

3. (a) Critically discuss the need for having two separate layers for "Transport" and "Network". Illustrate your answer with suitable examples. [5]

(b) i. List two examples each where connection oriented and connectionless transport protocols are used. [2]
ii. For each example, justify the use of the relevant protocol. [4] 6

(c) i. Clearly explain the role of NAT in the conservation of IPv4 address space. [3]
ii. Explain different types of NATs with suitable sets of examples. [3]
iii. Briefly explain the possible disadvantages of using NAT in the current context where significant peer to peer applications (E.g. VOIP) are used over Internet Prototocol. [3]

4. (a) Critically analyze the drawbacks of classful routing with respect to classless routing. Illustrate your answer with appropriate examples. [5]

(b) A service provider has two networks.

- Network N1 - 220.230.30.128/25
- Network N2 - 220.230.32.0/21

Network N1 is assigned to 3 clients A,B and C who require 25, 10 and 10 IP addresses respectively. Network N2 is assigned to 2 clients D and E who require 275 and 550 IP addresses respectively.

For each client determine the following. (Clearly show the steps you follow in getting your result).

- Network Address in CIDR notation.
- Subnet mask
- Broadcast address

[15]

5. PCM block of a transmitter is used to digitize a continuous signal with the following properties.
   a. Signal bandwidth = 15 kHz
   b. No. of discrete signal levels = 256
   c. S/N Ratio of the transmission channel = 20dB

   (i) State Shannon's equation for determining channel capacity and clearly explain the meaning of each term. [4]
   (ii) Using the equation in (i), determine the minimum bandwidth of the channel required to transmit the digitized signal given above. [12]
   (iii) Suggest a way of reducing the data rate of this transmitter and describe possible issues that might arise in using this method. [4]

6.

(a) i. By taking a Fully Qualified Domain Name (of at least 4 levels) of your choice, clearly explain the DNS name resolving process. [4]
ii. Illustrate with a suitable example, the significance of "DNS Reverse Mapping". [2]

(a) RIP and OSPF are two main interior routing protocols used within an autonomous system.
   a. Clearly explain how routing tables are built in these two protocols. [4]
   b. Comment on the effectiveness of the approaches of RIP and OSPF. [2]

(b) Consider the network with link costs shown in figure Q6 below. Use fixed routing to draw:
   a. the central routing directory and
   b. directories at nodes A, B and G

Hence determine the shortest path from A to H. [8]

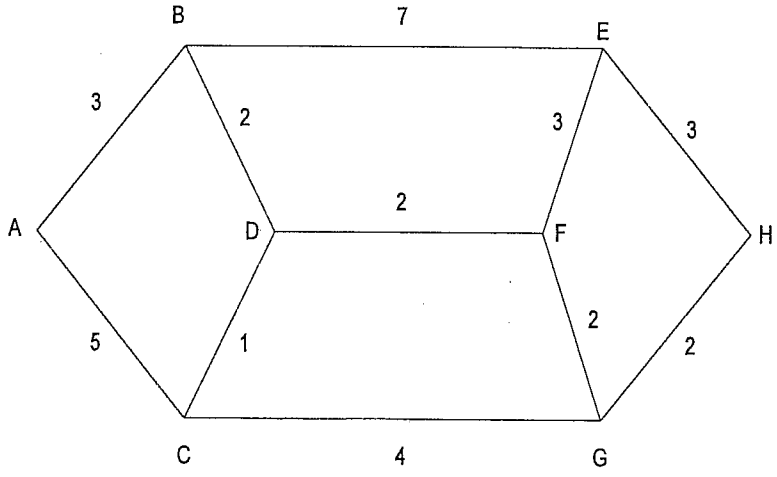

Figure Q6

7. (a) Explain what is meant by an A/S/n queuing system and, in particular, what is meant by a M/M/1 queuing system. [4]

(b) A communication channel has the capacity of K bits/second. Data packets arrive at the channel according to a Poisson process with rate λ=300 packets per minute. The packets have an exponentially distributed length with a mean of v= 4000 bits. We assume that the channel can be modeled as an M/M/1 system with queuing discipline FCFS (First- Come- First- Served).

(i) Determine the minimum value of K which ensure that the average total waiting time T, spent in the system by a customer, is less than or equal to T= 0.25 seconds. [8]

(ii) Find μ(average service rate) and the expected waiting time W for that value of K. [8]

8. (a) Explain the terms *even parity* and *odd parity*. Is one method better than the other? [4]

(b) Consider the transmission of an 8-bit character. If errors occur when transmitting bits 3 and 5, will even-parity checking detect the error? [4]

(c) Describe the operation of a cyclic redundancy code. What is the main difference between this code and a simple parity check? [4]

(d) Calculate the checksum for the polynomial x^3+x+1 and message 10010010 (x^7+x^4+x). On reception an error syndrome of x^5 has occurred, show that this is detected by the receiver. [8]