Department of Electrical & Computer Engineering
Prairie View A&M University

Doctoral Preliminary Examination

Computer Networks
Spring 2016

Name of the student: _____

Signature of the student: _____

1	30	
2	20	
3	25	
4	25	
Total	100	

Instructions:

This is a CLOSED BOOK Examination. You can use approved calculator. You can access the Formulae sheet provided by the Graduate Coordinator who is administering the examination.

(30 pts) 1.

(a) Find the relationship between bit energy over noise spectral density E_b/N_0 and the measured signal-to-noise ratio (SNR) S/N. Clearly indicate how pulse shaping roll-off factor (r) and the size of digital signal constellation (M) impact the above relationship. **[4 points]**

(b) The probability of bit error (P_b) versus E_b/N_0 is commonly used as the reference measure when characterizing the network performance at the physical (PHY) layer. Explain why E_b/N_0 is more desirable than the SNR measure? **[4 points]**

(c) A telephone line with a bandwidth of 100 Hz is known to have a loss of 20 dB. The input signal power is measured as 0.5 W, and the output signal noise level is measured as 2.5 μW. Using this information, calculate the channel capacity for the telephone channel. What does this quantity reveal? **[10 points]**

(d) Assume that a telephone-line channel is equalized to allow bandpass transmission over a frequency range of 600 to 3000 Hz. The available bandwidth is 2400 Hz with a center frequency of 1800 Hz.

(i) For pulse shaping roll-off factor r = 0.5, evaluate the required transmission bandwidths for 2400 bps quadrature phase-shift-keying (QPSK) and 4800 bps 8-PSK (eight-level phase-shift-keying). Is the available bandwidth adequate? **[4 points]**

(ii) Draw the constellation diagram of a QPSK digital modulation with an appropriate symbol-to-bit mapping. **[4 points]**

(iii) Sketch a digital receiver for demodulating the QPSK waveform. **[4 points]**

(20 pts) 2.

(a) Briefly list and describe four design considerations in the selection of line codes (data encoding in pulse code modulation). **[10 points]**

(b) Given the incoming data stream 0 1 1 1 0 1 1, sketch the binary line codes for the following two encoding schemes:

(i) Bipolar Alternate Mark Inversion **[5 points]**

(ii) Split-Phase (Manchester code) **[5 points]**

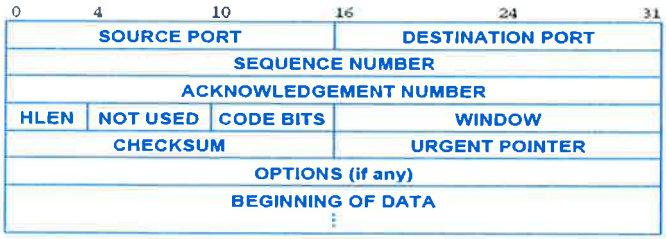
(25 pts) 3. The diagram below shows a TCP connection between Hosts H_A and H_B passing through networks with different values of Maximum Transmission Unit (MTU) shown below. IPv4 is in use.

(10pts) (a). Assume Host H_A wants to deliver a TCP segment to H_B with **3000 bytes of data from application layer** (TCP and IP headers are each 20 bytes in size).
Describe the way in which fragmentation takes place as H_A sends data to H_B. Explain the process, such as (i) which router will perform the fragmentation? (ii) Who will be responsible for the reassembly? (iii) Then fill the table below to show the arithmetic used to calculate fragment sizes.

Fragment #	Total Bytes	Header Bytes	Data Bytes	Fragment Flag	Fragment Offset (8 byte blocks)

(10pts) (b). What are the techniques a transport protocol use to handle the problems listed in the following table? Please fill the table and briefly explain. TCP header format is attached for your reference.

Techniques	**Problem**
parity bits, a checksum, or a cyclic redundancy check (CRC)	Detect error (track transmission error)
	duplicates and out-of-order delivery
	lost packets
	prevent data overrun
	avoid congestion



(5pts) (c) What are the key functions of the Transport layer? Please briefly explain the differences between TCP and UDP?

(25 pts) 4. IP Addressing: Assume an Internet Service Provider (ISP) has a Classless Inter-Domain Routing (CIDR) address block 135.231.160.0/21 ,

(4 pts) (4.1) What is the address mask?
(3 pts) (4.2) What is the network address?
(4 pts) (4.3) How many hosts can the network accommodate? What will be the address range?
(6 pts) (4.4) Suppose the ISP has 2 customers, customer A needs 32 IP addresses, customer B needs 288 IP addresses. Could you help the ISP assign the address block to the two customers, explain how.
(4 pts) (4.5) What are the key functions of the network layer?
(4 pts) (4.6) Assuming TCP/IP reference model is adopted, what layers of the protocol stack are used on a router? How about a host?