KFUPM - COMPUTER ENGINEERING DEPARTMENT

COE-540 – Computer Networks – Assignment 3 – Due Mon Nov 14th, 2011

Student Name:
Student Number:

Problem	Total Points	Points
1	10	
2	20	
3	20	
4	10	
5	10	
6	30	
Total	100	

Problem 1 (10 points): Suppose that data are transmitted in blocks of sizes 1000 bits. What is the maximum bit error rate under which error detection and retransmission mechanism (1 parity bit per block) is better than using Hamming code? Assume that bit errors are independent of one another and no bit error occurs during retransmission.

Problem 2 (20 points): A block of bits with n rows and k columns uses horizontal and vertical parity bits for error detection. Suppose that exactly 4 bits are inverted due to transmission errors on the channel.

a) What is the total number of all 4-bit error patterns in this n by k bits block.

b) Derive an expression for the probability that the 4-bit error will be undetected.

c) Compute the probability of 4-bit error be undetected for n = 3 and k = 3.

d) Compute the probability of 4-bit error be undetected for n = 10 and k = 8.

Problem 3 (20 points): Consider the PPP protocol and the material in textbook section 3.5.

a) What is the minimum overhead to send an IP packet using PPP? Count only the overhead introduced by PPP itself, not the IP header overhead. What is the maximum overhead?

b) A 100-byte IP packet is transmitted over a local loop using ADSL protocol stack. How many ATM cells will be transmitted? Briefly describe their content.

Problem 4 (10 points):

Let the number of events, N, in a given period of t seconds be a Poisson random variable (RV) with average equal to λt. Prove that the interarrival time denoted by the random RV τ, follows the exponential distribution with mean equal to λ^{-1}.

Hint: consider the distribution of the interval where 0 events occur. This interval is the interarrival time.

Problem 5 (10 points):

Let N_1 and N_2 be Poisson RVs with rates λ_1 and λ_2 events per time unit, respectively.

a) Compute the probability generating function (PGF) $G_{N_1}(z)$ for the RV N_1.

b) Consider the new RV $N = N_1 + N_2$. Show that N is a RV that has a Poisson distribution with rate $\lambda_2 = \lambda_1 + \lambda_2$.

Hint: the PFG for the new RV N is given by $G_N(z) = G_{N_1}(z) \times G_{N_2}(z)$.

Problem 6 (30 points):

Data in the form of fixed-length packets arrive in slots on the FOUR input lines of a multiplexer. A slot contains a packet with probability p, independent of the arrivals during other slots or on the other line. The multiplexer transmits one packet per time slot and has the capacity to store THREE packets only. If no room for a packet is found, the packet is dropped.

a) COMPUTE the probability of j (for all possible j values) packets arriving on the four input lines during any given time slot. What is the average and standard deviation of the number of packets arriving at the multiplexer input?

b) DRAW the state transition diagram and SPECIFY the transition matrix **P** – The state is taken to be the number of packets in the multiplexer.

c) If p is equal to 0.4, what is the probability that the MUX will contain 0 packets after 10 time slot (i.e. at the start of the 11th time slot)? Assume that we start with an empty MUX. Plot the PMF for the state distribution for the first 10 time slots.

d) Let the load be defined as the mean number of arriving packets per time slot while throughput be defined as the mean number of transmitted packets per time slot. Use Matlab to obtain the results for:

1) Plot the throughput versus the input load for values of p ranging from 0 to 1.
2) Evaluate and plot the mean number of packets in MUX buffer at a time slot versus the input load for values of p ranging from 0 to 1.