Name________________________

EE602 Test 1

Oct. 2, 6:30 - 8:30 PM

(1) The test has six questions for a total of 40 points.

(2) Clearly show your work if you want to get partial credit.
(3) State your assumptions, if any.
(4) Formulae are given on the last page of the test. You can detach it from the rest of the test if you like.

Question	Max. points	Points Scored
1	4	
2	5	
3	8	
4	8	
5	11	
6	4	
Total	40	

(1) (a) Show (or argue) that two dimensional parity can always detect odd number of errors. (2 points)

(b) Consider a two dimensional parity code with K data rows (plus one parity row) and J data columns (plus one parity column). What can we conclude about the number of errors if both the parity of the (K+1)st row and the parity of the (J+1)st column don't match. (2 points)

(2) (a) Suppose the following sequence of bits arrives over a link:
110101111101011111001011110101111110
Show the resulting frame after any stuffed bits have been removed. (2 points)

(b) Let g(x) = $x^5 + x + 1$. Generate the codeword for information bits = (1,1,0,1,1,0,1,0). (3 points)

(3) Suppose you are designing a selective reject protocol for a 1Mbps point-to-point link to another planet which has a one-way latency of 2.0 seconds. Assume that data is traveling in **both** directions, a frame starts as soon as the previous frame is complete. Each frame is a maximum of 1024bits, a minimum of 256bits. In the absence of errors or lost frames,
(a) Let T_{max} be the maximum frame tranmission time and t_{prop} be the one-way propagation delay. Write an equation for T_f in terms of T_{max} and t_{prop}, where T_f is the maximum time to get feedback from the receiver, regarding a previously transmitted frame. (3 points)

(b) What is the minimum window size, n, so as to avoid being unable to send data because the window is exhausted? (3 points)

(c) How would your answer to part (a) change if you only have acknowledgements coming back i.e., data is being transmitted in only one direction. (2 points)

(4) (a) A channel has a bit rate of 4kbps and a propagation delay of 25ms. If we use frames of 100 bits in the forward direction and ACKs of 20bits in the reverse direction, what is the expected efficiency of the channel? (2 points)

(b) What is the expected efficiency on the same channel with a Go-back-7 protocol? (2 points)

(c) If the probability of packet loss is 0.5, how long does it take to transmit a frame in both the protocols? (4 points)

(5) A communication node A receives Poisson traffic from two other nodes, 1 and 2, at rates λ_1 and λ_2, resepctively, and transmits it, on a first-come first-serve basis, using a link with capacity C bits/sec. The two input streams are assumed independent and their packet lengths are identically and exponentially distributed with mean L bits. A packet from node 1 is always accepted by A. A packet from node 2 is accepted only if the number of packets in A (in queue or under transmission) is less than a given number $K > 0$; otherwise, it is assumed lost.

(a) What is the range of values of λ_1 and λ_2 for which the expected number of packets in A will stay bounded as time increases? (3 points)

(b) Draw a state transition diagram of the queue at A. (3 points)

(c) For λ_1 and λ_2 in the range of part (a), find the steady-state probability of having n packets in A. (5 points)

(6) (a)Assume questions in this exam take a random amount of time to solve with an exponentail distribution of mean 10 minutes. What is the probability that this exam of 6 questions cannot be completed in 2 hours? (1 point) What is the probability that the exam can't be completed if you arrive 30 minutes late? (1 point)

(b) Assume you are at a mall and are trying to use the public telephones. People arrive at the telephone at a rate of 2 per minute and an an average call lasts 5 minutes. On an average, how long do you spend at the telephone (including the waiting time)? (2 points)

Course Feedback

(1) How do you feel the course is going?

(2) What can be done to make it better?

Formulae:

Little's Formula $N = \lambda * T$
M/M/1/K Probability (# of customers = n) = $(1-\rho)\rho^n/(1-\rho^{K+1})$
M/M/1/K Probability(# of customers = 0) = $(1-\rho)/(1-\rho^{K+1})$
M/M/1 Average #of packets in system =$\rho/(1-\rho) = \lambda/(\rho-\lambda)$
M/M/1 Average # of packets in queue = $\rho^2/(1-\rho)$
M/M/1 Average Waiting time = $\rho/(\mu-\lambda)$
M/M/1 Average Time in System = $1/(\mu-\lambda)$
M/G/1 Waiting time = Residual service time/ $(1-\rho)$
M/G/1 Waiting time = $\lambda E[X^2]/2(1-\rho)$
M/D/1 Waiting time = $\rho/(2\mu(1-\rho))$