P1. Suppose the information content of a packet is the bit pattern 1010 0111 0101 1001 and an even parity scheme is being used. What would the value of the field containing the parity bits be for the case of a two-dimensional parity scheme? Your answer should be such that a minimum-length checksum field is used.

1 1 1 0 1
0 1 1 0 0
1 0 0 1 0
1 1 0 1 1
1 1 0 0 0

P3. Suppose the information portion of a packet contains six bytes consisting of the 8-bit unsigned binary ASCII representation of string "CHKSUM"; compute the Internet checksum for this data.

  0100 1100 0110 1001
+ 0110 1110 0110 1011
= 1011 1010 1101 0100
+ 0010 0000 0100 1100
= 1101 1011 0010 0000
+ 0110 0001 0111 1001
= 0011 1100 1001 1010
+ 0110 0101 0111 0010
= 1010 0010 0000 1100

so the complement is:
0101 1101 1111 0011

P5. Consider the generator, G = 1001, and suppose that D has the value 11000111010. What is the value of R?

r = 4
G = 10011
D = 1010101010
R = 1010101010 * 2^4 mod 10011 = 0100

P7. In this problem, we explore some of the properties of the CRC. For the generator G (= 1001) given in Section 6.2.3, answer the following questions.

a. Why can it detect any single bit error in data D?

b. Can the above G detect any odd number of bit errors? Why?

a. Assuming that the ith bit is flipped without loss of generality, where 0<= i <= d+r-1, and the least significant bit is the 0th bit. A bit error means that the data received is K=D*2r XOR R + 2i. If we divide K by G, the reminder is not zero. Generally, a bit error can always be detected if G contains at least two ones.

b. G is divisible by 11, but any odd number 1 is not divisible by 11. So, the odd bit error sequence can't be divided by 11, so it can't be divided by G.

P10. Consider two nodes, A and B, that use the slotted ALOHA protocol to contend for a channel. Suppose node A has more data to transmit than node B, and node A's retransmission probability p_A is greater than node B's retransmission probability, p_B.

a. Provide a formula for node A's average throughput. What is the total efficiency of the protocol with these two nodes?

b. If $p_A = 2p_B$, is node A's average throughput twice as large as that of node B? Why or why not? If not, how can you choose p_A and p_B to make that happen?

c. In general, suppose there are N nodes, among which node A has retransmission probability $2p$ and all other nodes have retransmission probability p. Provide expressions to compute the average throughputs of node A and of any other node.

a.
pA (1 - pB)
pA (1 - pB) + pB (1 - pA)

b.
A: pA (1 - pB) = 2pB (1 - pB)
B: pB (1 - pA) = pB (1 - 2pB)

A is not the twice as large as B
pA (1 - pB) = 2pB (1 - pA) => pA = 2 - pA/pB

c.
A: 2p (1 - p) N - 1
Other: p (1 - p) N – 2 (1 - 2p)