HW3

1. (10 points) A bit string, 0111101111101111110, needs to be transmitted at the data link layer. What is the string actually transmitted after bit stuffing?

01111110 011110111110011111010 01111110

1. (10 points) What is the remainder obtained by dividing x7 + x5 + 1 by the generator polynomial x3 + 1?

10100001 / 1001 = 10110 …… 111 （mod 2, xor）

x^2 + x + 1

3. (10 points) Data link protocols almost always put the CRC in a trailer rather than in a header. Why?

因为CRC是在发送/接收到整个帧的数据之后才能计算出来的，如果放在头部的话，就要先把整个帧存下来，算出CRC之后，先发CRC，放到帧头里，再发送，这样增加了设备制造难度和发送延迟。

4. (10 points) A 100-km-long cable runs at the T1 data rate. The propagation speed in the cable is 2/3 the speed of light in vacuum. How many bits fit in the cable?

T1 data rate = 1.544 Mbps

传播速率=2 \* 10^8 m/s

传播延迟=100km / (2\*10^8 m/s)= 0.0005 s

容纳比特数=带宽\*延迟 = 1.544Mbps \* 0.0005s = 772 bits

5. (40 points) Consider an error-free 64-kbps satellite channel used to send 512-byte data frames in one direction, with very short acknowledgements coming back the other way. What is the maximum throughput for window sizes of 1, 7, 15, 127? The earth-satellite propagation time is 270 msec. (give your answer as an integer)

数据率R=64kbps  
数据帧大小L=512 bytes=4096 bits  
单向传播时间t\_prop=0.27s  
帧发送时间t\_trans=4096 bits / 64kbps = 0.064s

RTT=t\_trans + 2 \* t\_prop = 0.604  
设窗口大小W

利用率U=min(W\*T/RTT, 1)

吞吐量=U \* R = min(6781.457\* W, 64000) bps

当W=1，throughput=6781 bps

当W=7，throughput=47470 bps

当W=15，throughput=64000 bps

当W=127，Throughput=64000 bps

1. (10 points) A channel has a bit rate of 4 kbps and a propagation delay of 20 msec. For what range of frame sizes does stop-and-wait give an efficiency of at least 50 percent?

带宽B=4kbps

延迟t\_prop=0.02 s  
设帧大小L bits

帧传输时间t\_frame=L/B  
效率η=t\_frame/(t\_frame+2 t\_prop)=(L/B)/(L/B+2 t\_prop) >= 50%  
L > 160bits

7. (10 points) Alice and Bob agrees to use Hamming codes to encode message which has 7 data bits and 4 check bits with even parity sums. Now Bob receives a message:

0 0 1 0 0 1 0 1 0 0 1

Bits are numbered from left to right, starting with 1. please help Bob to check the message.

Does it has error? If has, which bit is error?

C\_1 = P\_1 ^ P\_3 ^ P\_5 ^ P\_7 ^ P\_9 = 0 Pass

C\_2 = P\_2 ^ P\_3 ^ P\_6 ^ P\_7 ^ P\_19 ^ P\_11 = 1 Fail

C\_4 = P\_4 ^ P\_5 ^ P\_6 ^ P\_7 = 1 Fail  
C\_8 = P\_8 ^ P\_9 ^P\_10 ^ P\_11 = 0 Pass

(0110)2 = 6

There is error, the error bit is 6.