1. Consider the following message M = 1010001101. The cyclic redundancy check (CRC) for this message using the divisor polynomial $x^5+x^4+x^2+1$ is

A. **01110** B. 01011 C. 10101 D. 10110

Answer: Option A

Explanation:

The generator polynomial is of degree 5, so append five 0's to the end of data
Therefore, New message= 101000110100000.
Generator polynomial = $x^5+x^4+x^2+1$ = 110101
Divide the new message by generator polynomial will get 01110 as the remainder.
CRC= Remainder= 01110.

2. How many data elements can be carried by each signal if the signal has a bit rate of 9000 bps and a baud rate of 3000 baud?

A. 0.336 bits/baud **B. 3 bits/baud**
C. 120,00,000 bits/baud D. None of these

Answer: Option B

Explanation:
Baud is unit for signal and bits are units for data.
So, The question is how many bits can be transferred in a single baud.
Given 9000 bits per sec and 3000 baud(signals) per sec,
I.e. 9000 bits are transmitted in 3000 baud(signals)
Then for each baud, 3 bits must be sent.

3. 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, and 127? The earth-satellite propagation time is 270 msec.

A. 6.4Kbps, 47.48Kbps, 9.6Kbps, 81.7Kbps
B. 6.4Kbps, 47.36Kbps, 64 Kbps, 64 Kbps
C. 6.4Kbps, 52.2Kbps, 101.6Kbps, 81 Kbps
D. 6.4Kbps, 47.3Kbps, 59.6Kbps, 64Kbps

Answer: Option B

Explanation:

Tt(transmission Delay) = length / Bandwidth

= (512*8)bits / ($64*10^3$)bps

= 64 msec

Tp(Propagation Delay) = 270ms

Efficiency for window size 1 ⇒ 1/(1+2(270/64))

⇒ 1/9.4375 ⇒ 0.10

Throughput = Efficiency * Bandwidth = 0.10 * 64Kbps = 6.4Kbps

Efficiency for window size 7 ⇒ 7/9.4375 ⇒ 0.74

Throughput = Efficiency * Bandwidth = 0.74 * 64Kbps = 47.36Kbps

Efficiency for window size 15 ⇒ 15/9.4375 ⇒ 1.59

Throughput = Efficiency * Bandwidth = 1.59 * 64Kbps = 101.76Kbps

But the maximum bandwidth available is 64Kbps. So with window size 15, Throughput = 64Kbps.

Likewise, for window size 127, maximum throughput = 64kbps.

4. A bit stream 10011101 is transmitted using the standard CRC method. The generator polynomial is x^3+ 1. Suppose the third bit from the left is inverted during transmission. What will be the bit string at the receiver's end?

A. 1 0 1 1 0 1 0 1 1 0 0

B. 1 0 1 1 1 1 0 1 0 0 0

C. 1 0 0 1 1 1 0 1 1 0 0

D. 1 0 1 1 1 1 0 1 1 0 0

Answer: Option D

Explanation:

Our generator G(x) = x^3+ 1 is encoded as 1001 because the generator polynomial is of the degree three; we append three zeros to the lower end of the frame to be transmitted. Hence, after appending the 3 zeros, the bit stream is 10011101000. By dividing the message by generator after appending three zeros to the frame, we get a remainder of 100. We do modulo 2 subtraction after that of the remainder from the bit stream with the three zeros appended. The actual frame transmitted is 10011101100. See below.

Remainder = 100

Actual correct data = 1 0 0 1 1 1 0 1 1 0 0

The third bit from the left is garbled, and the frame is received as

1 0 1 1 1 1 0 1 1 0 0

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1001) 1 0 0 1 1 1 0 1 0 0 0   (
      1 0 0 1
      -------------------------
      0 0 0 0 1 1 0 1 0 0 0
              1 0 0 1
        ----------------------------
              0 1 0 0 0 0 0
                1 0 0 1
          ----------------------------
                0 0 0 1 0 0
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5. Suppose the information portion of a packet contains 10 bytes consisting of the 8-bit binary representation of the numbers 1 through 10. Compute the Internet (IP) checksum for this data.

A. 11100110 11100001	B. 11100110 11101001
B. 00011001 00010110	D. 00011001 00011110

Answer: Option A
Explanation:

Here, we need to find an Internet(IP) checksum, which means 16-bit checksum.
There is another way of calculating the checksum. Do simple binary addition, then 1's complement.
00000001 00000010
00000011 00000100
00000101 00000110
00000111 00001000
00001001 00001010

00011001 00011110
The one's complement of the sum is 11100110 11100001.

6. Consider the generator, G=10011, and suppose that data in binary is 1010101010. What is the data ready to be sent after CRC calculation?

A. 10101010101100	B. 10101010100101
C. 10101010100100	D. 10101010101000

Answer: Option C

Explanation:
To calculate CRC, we need to add 4 0's at the end of the data (because the generator has a degree of 4, i.e., 5 bits). If we divide 10011 into 1010101010 0000, we get the remainder of R=0100. So the data is 10101010100100

7. ……………… control refers to a set of procedures used to restrict the amount of data that the sender can send before waiting for an acknowledgement.

(A) Error **(B) Flow** (C) Transmission (D) All of the these

Answer: Option B

8. Assuming that you are designing the sliding window protocol for a 1 Mbps point-to-point link to the moon. Which has a one-way latency(Delay) of 1.25 sec. Assume that each frame carries 2 KB of data; what is the minimum number of bits needed for the sequence number?

(A) 10 **(B) 8** (C) 9 (D) 7

Answer: Option B
Explanation

Tp=1.25 sec, Tt=L/B=2*1024*8/10^6=0.016384 sec

# of bits required in sequence # field is always equal to the sender window size(SWS)

SWS=1+2a (a=Tp/Tt), a= 1.25/0.016384 =76.293

SWS= 1+2*76.293=153.58

By default, sliding window means Go_Back N ARQ,

so here, K= 2^n-1

N = $\lceil \log_2 153.58 \rceil$ =8 bits

9. Suppose there is exactly one packet switch between a sending host and a receiving host. The transmission rates between the sending host and the switch and between the switch and the receiving host are R1 and R2, respectively. Assuming that the switch uses store-and-forward packet switching, what is the total end-to-end delay in sending a packet of length L?

(Ignore queuing, propagation delay, and processing delay.)

A. 2L/(R1 + R2).
B. L/R1 + L/R2.
C. 2L/R1*R2.
D. L*R1 + L*R2.

Answer: Option B

Explanation:

At time t0, the sending host begins to transmit. At time t1= L/R1, the sending host completes transmission, and the entire packet is received at the router (no propagation delay).

Because the router has the entire packet at time t1, it can begin to transmit the packet to the receiving host at time t1. At time t2 = t1 + L/R2, the router completes transmission and the entire packet is received at the receiving host (again, no propagation delay).

Thus, the end-to-end delay is L/R1 + L/R2.

10**. Assume there is a satellite communication link between the moon and Earth with a capacity of 1 Mbps. The communication is happening between the moon and earth with 1000-bit frames and takes 270-ms one-way delay. What is the maximum link utilization if we use**
1. Stop-and-wait flow control and
2. Flow control with a window size of 7.

A. 1→ 0.012, 2 → 0.022

B. 1→ 0.002, 2 → 0.013

C. 1→ 0.02, 2 → 0.0013

D. 1→ 0.017, 2 → 0.002

Answer: Option B

Explanation:

For stop-and-wait: Utilization = 1/(1+2a)

For Continuous flow control(SR or GO-back-N):Utilization = W/(1+2a)

Where, a = (Propagation Time)/ (Transmission Time)

Now, Transmission Time = (Frame Length) / (Data Rate)

The following values are given:

Propagation Time = 270 ms = 270 x 10^{-3}sec

Frame Length = 1000 bits

Data Rate = 1Mbps= 1 x 10^{6} bps

Therefore, a = (270 x 10^{-3}) / (1000 / 10^{6}) =270

1. U = 1 / (1+2a) = 1 / (1+2 x 270) = 1/541 = 0.002
2. U = W / (1+2a) = 7 / (1+2 x 270) = 7/541 = 0.013