**Name**: Trần Thanh Dương

**Class**: AI1601

**ID**: SE160185

**Q.1**

(a) In a three-way handshake procedure, one must ensure the selection of the initial sequence number is always unique. If station B receives an old SYN segment from A, B will acknowledge the request based on the old sequence number. When A receives the acknowledge segment from B, A will find out that B received a wrong sequence number. Station A will discard the acknowledgement packet and reset the connection.

(b) If an old SYN segment from A arrives at B, followed by an old ACK segment from A to a SYN segment from B, the connection will also be rejected. Initially, when B receives an old SYN segment, B will send a SYN segment with its own distinct sequence number set by itself. If B receives the old ACK from A, B will notify A that the connection is invalid since the old ACK sequence number does not match the sequence number previously defined by B. Therefore, the connection is rejected.

**Q.2**

**G(x) = x^3 + 1** encoded as **1001**.

Added **3 zeros** to the end of the frame to be transmitted (because the degree of G(x) is 3): **10011101000**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 |
|  |  |  |  | 1 | 0 | 0 | 1 |  |  |  |  |  |  |  |
|  |  |  |  | 0) | 0 | 0 | 0 | 1 |  |  |  |  |  |  |
|  |  |  |  |  | 0 | 0 | 0 | 0 |  |  |  |  |  |  |
|  |  |  |  |  | 0) | 0 | 0 | 1 | 1 |  |  |  |  |  |
|  |  |  |  |  |  | 0 | 0 | 0 | 0 |  |  |  |  |  |
|  |  |  |  |  |  | 0) | 0 | 1 | 1 | 0 |  |  |  |  |
|  |  |  |  |  |  |  | 0 | 0 | 0 | 0 |  |  |  |  |
|  |  |  |  |  |  |  | 0) | 1 | 1 | 0 | 1 |  |  |  |
|  |  |  |  |  |  |  |  | 1 | 0 | 0 | 1 |  |  |  |
|  |  |  |  |  |  |  |  | 0) | 1 | 0 | 0 | 0 |  |  |
|  |  |  |  |  |  |  |  |  | 1 | 0 | 0 | 1 |  |  |
|  |  |  |  |  |  |  |  |  | 0) | 0 | 0 | 1 | 0 |  |
|  |  |  |  |  |  |  |  |  |  | 0 | 0 | 0 | 0 |  |
|  |  |  |  |  |  |  |  |  |  | 0) | 0 | 1 | 0 | 0 |
|  |  |  |  |  |  |  |  |  |  |  | 0 | 0 | 0 | 0 |
|  |  |  |  |  |  |  |  |  |  |  | 0) | **1** | **0** | **0** |

Actual frame transmitted: **10011101100**

Suppose the 3rd bit from the left is inverted during transmission: **10111101100**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
|  |  |  |  | 1 | 0 | 0 | 1 |  |  |  |  |  |  |  |
|  |  |  |  | 0) | 0 | 1 | 0 | 1 |  |  |  |  |  |  |
|  |  |  |  |  | 0 | 0 | 0 | 0 |  |  |  |  |  |  |
|  |  |  |  |  | 0) | 1 | 0 | 1 | 1 |  |  |  |  |  |
|  |  |  |  |  |  | 1 | 0 | 0 | 1 |  |  |  |  |  |
|  |  |  |  |  |  | 0) | 0 | 1 | 0 | 0 |  |  |  |  |
|  |  |  |  |  |  |  | 0 | 0 | 0 | 0 |  |  |  |  |
|  |  |  |  |  |  |  | 0) | 1 | 0 | 0 | 1 |  |  |  |
|  |  |  |  |  |  |  |  | 1 | 0 | 0 | 1 |  |  |  |
|  |  |  |  |  |  |  |  | 0) | 0 | 0 | 0 | 1 |  |  |
|  |  |  |  |  |  |  |  |  | 0 | 0 | 0 | 0 |  |  |
|  |  |  |  |  |  |  |  |  | 0) | 0 | 0 | 1 | 0 |  |
|  |  |  |  |  |  |  |  |  |  | 0 | 0 | 0 | 0 |  |
|  |  |  |  |  |  |  |  |  |  | 0) | 0 | 1 | 0 | 0 |
|  |  |  |  |  |  |  |  |  |  |  | 0 | 0 | 0 | 0 |
|  |  |  |  |  |  |  |  |  |  |  | 0) | **1** | **0** | **0** |

The remainder (**100**) shows that an error has occurred.

**Q.3**

(a) 135.46.63.10 in bits will be: **10000111.00101110.00111111.00001010**

Keep first 22 bits and turn remaining bits into 0: **10000111.00101110.00111100.00000000** 🡪 **135.46.60.0** (in decimal)

Therefore, the packet will forward to **Interface 1**.

(b) 135.46.57.14 in bits will be: **10000111.00101110.00111001.00001110**

Keep first 22 bits and turn remaining bits into 0: **10000111.00101110.00111000.00000000** 🡪 **135.46.56.0** (in decimal)

Therefore, the packet will forward to **Interface 0**.

**Q.4**

(a) **g1(x) = x + 1** is used as generating polynomial 🡪 **G = 11**

The degree of **g1(x)** is **1**.

Data to be sent: **1101100**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
|  |  | 1 | 1 |  |  |  |  |  |
|  |  | 0) | 0 | 0 |  |  |  |  |
|  |  |  | 0 | 0 |  |  |  |  |
|  |  |  | 0) | 0 | 1 |  |  |  |
|  |  |  |  | 0 | 0 |  |  |  |
|  |  |  |  | 0) | 1 | 1 |  |  |
|  |  |  |  |  | 1 | 1 |  |  |
|  |  |  |  |  | 0) | 0 | 0 |  |
|  |  |  |  |  |  | 0 | 0 |  |
|  |  |  |  |  |  | 0) | 0 | 0 |
|  |  |  |  |  |  |  | 0 | 0 |
|  |  |  |  |  |  |  | 0) | **0** |

The codeword will be: **1101100**

(b) **g2(x) = x^3 + x^2 + 1** is used as generating polynomial 🡪 **G = 1101**

The degree of **g2(x)** is **3**.

Data to be sent: **110110000**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  | 1 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
|  |  |  |  | 1 | 1 | 0 | 1 |  |  |  |  |  |
|  |  |  |  | 0) | 0 | 0 | 0 | 1 |  |  |  |  |
|  |  |  |  |  | 0 | 0 | 0 | 0 |  |  |  |  |
|  |  |  |  |  | 0) | 0 | 0 | 1 | 0 |  |  |  |
|  |  |  |  |  |  | 0 | 0 | 0 | 0 |  |  |  |
|  |  |  |  |  |  | 0) | 0 | 1 | 0 | 0 |  |  |
|  |  |  |  |  |  |  | 0 | 0 | 0 | 0 |  |  |
|  |  |  |  |  |  |  | 0) | 1 | 0 | 0 | 0 |  |
|  |  |  |  |  |  |  |  | 1 | 1 | 0 | 1 |  |
|  |  |  |  |  |  |  |  | 0) | 1 | 0 | 1 | 0 |
|  |  |  |  |  |  |  |  |  | 1 | 1 | 0 | 1 |
|  |  |  |  |  |  |  |  |  | 0) | **1** | **1** | **1** |

The codeword will be: **110110111**

**Q.5.**

TCP / IP over Ethenet allows data frames with a payload size up to 1460 bytes. Therefore, **L = 100, 500, 1000** are within this limit.

TCP: 20 bytes of header

IP: 20 bytes of header

Ethernet: 18 bytes of header and trailer

Therefore:

L = 100 bytes, efficiency

L = 500 bytes, efficiency

L = 1000 bytes, efficiency