**Q.1: Suppose a header consists of four 16-bit words: (11111111 11111111, 11111111 00000000, 11110000 11110000, 11000000 11000000). Find the Internet checksum for this code.**

The internet checksum equals sum of four words.

But the sum have 18 bits so we take 2 leftmost bits and add to 16 other bits.

Therefore, the internet checksum is: 1011 0000 1011 0010

Text

Description automatically generated with medium confidence

**Q.2: Consider the three-way handshake in TCP connection setup**

**a. Suppose that an old SYN segment from station A arrives at station B, requesting a TCP connection. Explain how the three-way handshake procedure ensures that the connection is rejected.**

**b. Now suppose that an old SYN segment from station A arrives at station B, followed a bit later by an old ACK segment from A to a SYN segment from B. Is this connection request also rejected?**

a. The first time A send a SYN segment to B with a sequence number (SYN-x) , B will send back a SYN-ACK segment to A with the acknowledge sequence number 1 more than the received sequence number (SYN-y-ACK-x+1)

The sequence number must be unique.

If B receive an old SYN segment from A (SYN-x), it will sent back a SYN-ACK segment (SYN-z-ACK-x+1). The sequence number x+1 is duplicate, therefore, the connection is rejected.

b. Yes, this connection is also rejected.

Initially when B recieves an old SYN segment from A, B will send a SYN segment with its own unique sequence number.

If B recieves an old ACK from A, B will identify that the old ACK sequence number doesnot match with the sequence number send by B previously and notify A that the connection is invalid.

**Q.3:**

**a.** 135.46.63.10 = 10000111.00101110.00111111.00001010

If a packet with IP address 135.46.63.10 arrives, we first compare it to the first entry of the router routing table: 135.46.56.0/22 (subnet mask = 11111111.11111111.11111100.00000000)

10000111.00101110.00111111.00001010

AND

11111111.11111111.11111100.00000000

= 10000111.00101110.00111100.00000000 = 135.46.60.0 (not equals the nework ip)

The second entry of the routing table: 135.46.60.0/22 (subnet mask = 11111111.11111111.11111100.00000000)

10000111.00101110.00111111.00001010

AND

11111111.11111111.11111100.00000000

= 10000111.00101110.00111100.00000000 = 135.46.60.0 (equals the nework ip)

Therefore, we forward the package to Interface 1

**b.** 135.46.57.14 = 10000111.00101110.00111001.00001110

If a packet with IP address 135.46.57.14 arrives, we first compare it to the first entry of the router routing table: 135.46.56.0/22 (subnet mask = 11111111.11111111.11111100.00000000)

10000111.00101110.00111001.00001110

AND

11111111.11111111.11111100.00000000

= 10000111.00101110.00111000.00000000 = 135.46.56.0 (equals the nework ip)

Therefore, we forward the package to Interface 0

**Q.4:** D = 110110

**a.** g1(x) = x+1 = 11

The generationg polynomial have 2 bit, so we add 1 bit to the data: 1101100

Divide module 2 1101100 by 11 we have R = 0

Therefore, the code word is 1101100

Text

Description automatically generated

**b.** g2(x) = x3+x2+1= 1101

The generationg polynomial have 4 bit, so we add 3 bit to the data: 110110000

Divide module 2 110110000 by 1101 we have R = 111

Therefore, the code word is 110110111

Text

Description automatically generated

**Q.5:** 1 megabyte = 2^20 \* 8 bits

**a.** 32 kilobit/s = 32000 bit/s

-> it take 2^20 \* 8 / 32000 = 262.144s to download 1 megabyte file

**b.** 1 megabit/s = 10^6 bit/s

-> it take 2^20 \* 8 / 10^6 = 8.388608s to download 1 megabyte file

**c.** compress with ratio of 1:6, the time taken to download the file will be 6 time faster:

a: 262.144/6 = 43.7s

b: 8.388608/6 = 1.4s