Question 2: [Marks: 2+2+5+5+5]

1. If the sequence number space is 32-bits long, what is maximum sender and receiver window sizes for GBN, and SR under following conditions

a) If the underlying communication medium can loss the packets, however, it cannot reorder them. Fill the following table to answer the question

	Go Back N	Selective Repeat
Receiver Window	1	2^32 -1 or 2^31
Sender Window	2^32 - 1	2^32 -1 or 2^31

b) If the underlying communication medium can loss and re-order the packets. Fill the following table to answer the question

	Go Back N	Selective Repeat
Receiver Window	1	2^32 /2
Sender Window	2^32 /2	2^32 /2

2. Consider the Go-Back-N protocol, with an infinite sender side window, and underlying medium which can loss and reorder the packets. Sequence number range starts from 0. Packets numbered from 0 to 7 are sent by the sender. However, few packets are lost in the network and remaining packets arrive at the receiver in the following order: 0,1,3,4,5,7

   a. What acknowledgment numbers are generated by the GBN receiver for each of the received packets.
   Fill in the table below to answer the question

Sequence number of the received packet	Acknowledgement Generated
0	0
1	1
3	1
4	1
5	1
7	1

b. Which packet(s) are resent by the GBN sender when the timer expires after a while?
2,3,4,5,6,7

3. Consider the Selective repeat(SR) protocol, with an infinite sender and receiver side window. Sequence number range starts from 0. Packets numbered from 0 to 7 are sent by the sender. However, few packets are lost in the network and remaining packets arrive at the receiver in the following order: 0,2,3,5,7

a. What acknowledgment numbers are generated by the SR receiver for each of the received packets? Fill in the table below to answer the question

Sequence number of the received packet	Acknowledgement Generated
0	0
2	2
3	3
5	5
7	7

b. Which packet(s) are resent by the SR sender when the timer expires after a while?
1,4,6

4. Consider the TCP's reliable data transfer protocol. The starting byte number in the data stream is 0. Five packets are sent with the respective lengths of 10, 20, 5, 10 and 30 bytes.

a. What are the sequence numbers for each of these five packets?

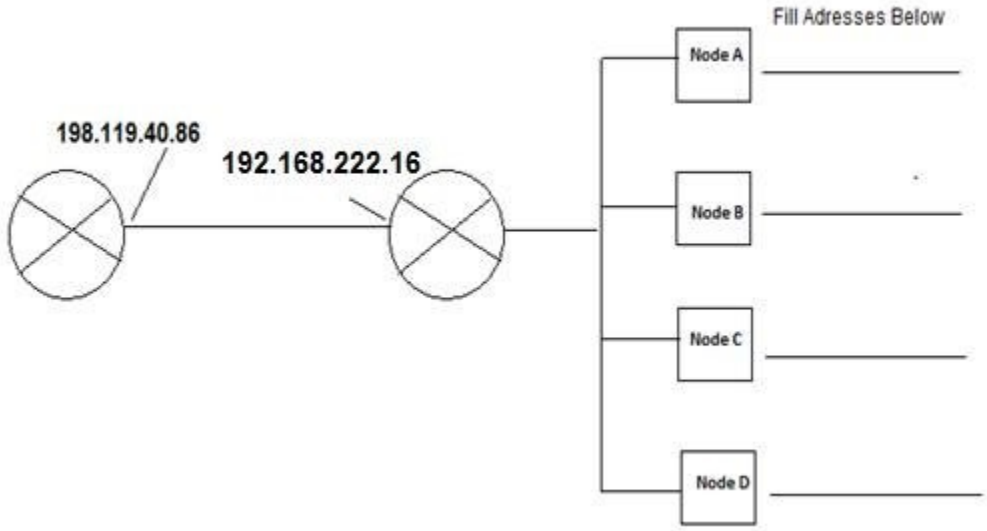
Packets #	Sequence Number
Packet 1	0

Packet 2	10
Packet 3	30
Packet 4	35
Packet 5	45

b. Assume that the underlying networks reorders the packets, and the receiver receives the packets in the following order: Packet1, Packet3, Packet5, Packet2 and Packet 4. What is the acknowledgement number generated for each of the received packets.

Packet #	Acknowledgement Generated
Packet 1	10
Packet 3	10
Packet 5	10
Packet 2	35
Packet 4	75

Question 3: Consider the figure below. [Marks: 1+4]



Suppose that the ISP assigns the router the address 192.168.222.16 and that the network address of the home network is 10.0.0.0/24.

a. Assign addresses to all interfaces in the home network. Fill in the blanks in the diagram above to answer this question

b. Suppose two hosts, Node A and Node C have ongoing TCP connections with the servers having IPs 198.119.40.86(Server 1) and 192.168.214.63(Server 2). Node A talks to these servers at port 80 and port 6534 respectively. Similarly Node C also talks to the server1 and server 2 at port 80 and port 7653. Provide the four corresponding entries in the NAT translation table below which help the four above mentioned TCP communications to work properly. Make appropriate assumptions if anything information is missing.

NAT Translation table	
WAN Side	LAN side
192.168.222.16 Port 1	10.0.0.1 Port 1
192.168.222.16 Port 2	10.0.0.2 Port 2
192.168.222.16 Port 3	10.0.0.3 Port 3
192.168.222.16 Port 4	10.0.0.4 Port 4

Question 4: Consider the following plot of TCP window size as a function of time. [Marks: 12]

Answer the following questions briefly. Please state the reason why you chose an answer.

1. According to you, which TCP flavor is this?

TCP reno because we see that the two losses are handled differently. i.e. triple duplication acks and timeout

2. What is the value of ssthreshold at 23rd transmission round? [Note: ssthreshold stands for slow start threshold]

The value is 4.

3. Identify all intervals of TCP slow start (E.g format: [3,9] meaning transmission round 3-9).

[1,5] and [17,19]

4. If a loss occurs at 25th transmission round, what will be the new values of ssthreshold and congestion window? Please state your answer in consideration to the type of loss occurred.

If loss is observed via triple duplicate acknowledgment, the ssthreshold value is: 5 and congestion window is: 5+3
If loss is of timeout the ssthreshold value is: 5 and congestion window is: 1

5. Identify all intervals of TCP congestion avoidance (E.g format: [3,9] meaning transmission round 3-9)

[5,9] , [10,14] , [15,16] and [19,25]

6. Calculate the number of segments sent in the transmission rounds range [9-18]. Both 9 and 18 are inclusive.

Transmission Round	Segments sent	Total segments sent
9	20	20
10	10	30
11	11	41
12	12	53
13	13	66
14	14	80
15	7	87
16	8	95
17	1	96
18	2	98