Subject :	**SEHH2238 : Computer Networking**
Lab/Tutorial :	**Session 9 : ARQ Protocols**

1. A sender sends a series of frames to the same destination using 5-bit sequence numbers. If the sequence number starts with 0, what is the sequence number after sending 100 frames?

2. Using 5-bit sequence numbers, what is the maximum size of the sender and receiver windows for each of the following protocols?

   (a) Stop-and-Wait ARQ
   (b) Go-back-N ARQ
   (c) Selective-Repeat ARQ

3. In a network using the Go-Back-N protocol with m=3 and the sending window of size 7, the values of variables are S_f = 62, S_n = 66, and R_n = 64. Assume that the network does not duplicate or reorder the packets.

   (a) What are the sequence numbers of data packets in transit?
   (b) What are the acknowledgement numbers of ACK packets in transit?

4. A system uses the Go-Back-N ARQ Protocol with a window size of 7. If each packet carries 1000 bits of data, how long does it take to send 1 million bits of data if the distance between the sender and receiver is 5000Km and the propagation speed is 2×10^8 ms^{-1}? Assume the channel data rate is 1 Mbps and ignore processing delays and ACK transmission time. Further assume that no data or control frame is lost or damaged. Also ignore the overhead due to the header and trailer. You may consider the ideal case scenario.

5. Repeat Q4 and consider the scenario that for every 7 ACKs, the first 6 ACK frames are lost but the last ACK frame is successfully received. Further assume that the timeout period is long enough to receive the 7^{th} ACK after sending a data frame. Also assume that the ACK of the last frame will not be lost.