Quiz 1

1. **(2M)** Among the 4 encoding techniques (line codes) covered in class, against each technique specify whether reversing the polarity of the wires (i.e. accidental inversion of leads from device to twisted pair) will cause errors in decoding the signal? Justify your answer.

2. **(1M)** The HDLC protocol uses a flag 01111110 at the start and end of frames. In order to prevent data bits from being confused with the flag, the sender stuffs a zero after every 5 consecutive ones in the data. Let us consider the following modification. Will the protocol work if we change the stuffing rule to stuff a zero only after "a zero followed by 5 consecutive ones in the data"? Justify your answer. 1M

3. **(1M)** A noiseless 8 KHz channel can support which of the following data rates (in kbps) if it employs a pulse that supports 4 distinct voltage levels? 1M
   - 16
   - 32
   - 64
   - 128

4. **(2M)** Suppose a receiver received the following sequence of bits: 010010101101. If CRC is used for error detection with a generator polynomial $x^4 + x^2 + 1$. Is there any error in the received bits? If so, how many bit errors occurred? If not, what was the transmitted message? Show your working.

5. Consider an asymmetric link A to B, where the A to B link bandwidth is 40kbps with a propagation delay of 120ms, however the B to A link bandwidth is 80kbps with a propagation delay of 70ms. Assume a data packet size of 1000 byte and an ACK size of 100 byte. Justify your answers, no marks for answers without steps/explanations.

   a. **(1M)** What is the throughput A can achieve in transmitting data to B if using Stop-and-Wait?

   b. **(1M)** If using the Sliding window protocol, what should the window size be in terms of packets?

   c. **(1M)** If using the sliding window protocol, what is the maximum rate A can achieve?

   d. **(1M)** If the bandwidth of the path from B to A drops to 800 bits per sec, rest parameters same as before. If still using the sliding window protocol with whatever window size is best, what rate can A achieve in the long run?