Minor - I

COL 334/672, Max. Marks: 40, Time: 1 hour

1. (20 marks) Answer each of the following briefly (A half page answer for each sub-question should suffice).
   (a) Suppose that the attenuation of a 10 MHz signal on CAT5 twisted pair cable is 20 dB per 300 metres. A 10 MHz signal of amplitude 1 volt is input to one end of a CAT5 twisted pair cable of length 6,000 metres. What is the amplitude of the signal at the other end of the cable?
   (b) Explain the working of *Differential Manchester Encoding*. Does it suffer from the problem of *baseline wander*? Explain why?
   (c) Explain the procedure of "sampling" and "quantization" to convert an analog voice signal to a digital signal.
   (d) Explain briefly one advantage of packet switching over circuit switching. Also explain one advantage of circuit switching over packet switching.
2. (10 marks) Figure 1 depicts a constellation diagram of a modulation scheme consisting of 8 constellation points. The coordinates of these constellation points are shown beside them.

   The transmitted signal $s(t)$ can be any one of the 8 constellation points. Assume that the received signal $r(t) = s(t) + n(t)$ where $n(t)$ is white Gaussian noise. We are ignoring attenuation and multipath here.
   (a) (6 marks) Draw the decision boundaries for various constellation points. Essentially these are the regions in which (r_x, r_y) will be mapped to a particular constellation point. Here r_x and r_Y are the inner products of the received signal $r(t)$ with the normalized cosine $(\cos(2\pi f_0 t))$ and sine functions $(\sin(2\pi f_0 t))$. You should mark the coordinates of any significant points (e.g. intersections with axes) of the decision areas in your diagram. (In the example of BPSK in class, the X-axis separated the two decision areas for the two BPSK constellation points.)
   (b) (4 marks) Assign 3 bits to each constellation point while trying to keep the probability of bit error minimum.

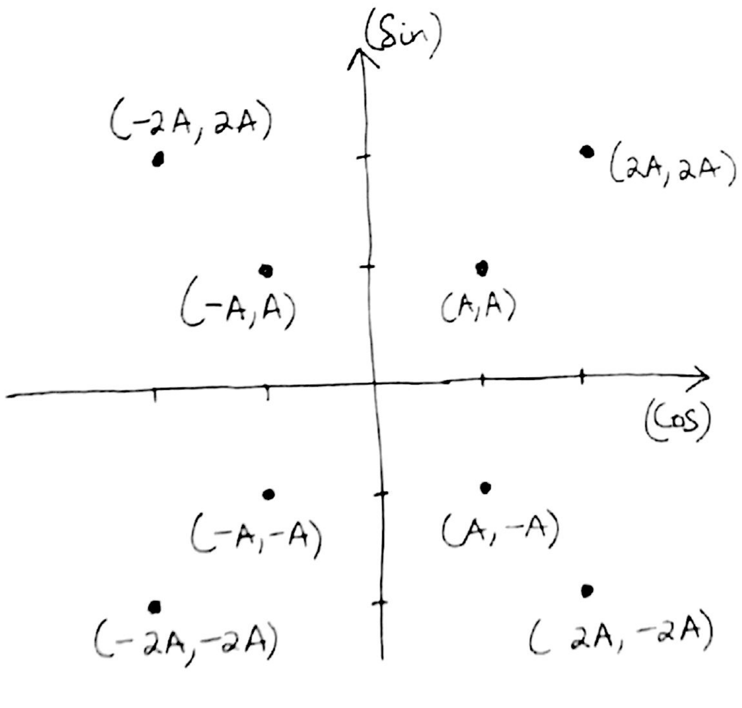

Figure 1: Constellation Diagram

3. (10 marks) Figure 2 depicts a sender connected to a receiver through two switches S_1 and S_2. Both switches use the store and forward method and FIFO output queuing described in class. Queues can be assumed to be of infinite size (in bits). The link capacities of the 3 links on the path from sender to receiver are $1.5C$ bits/sec, C bits/sec, and $2C$ bits/sec as shown.

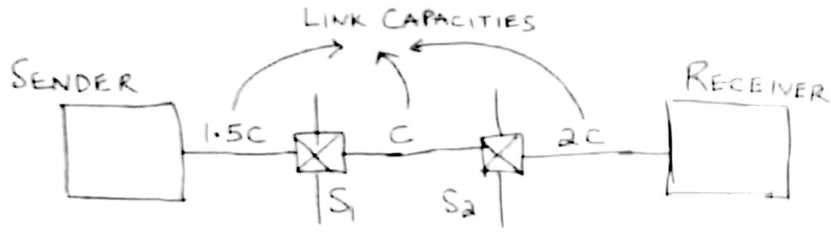

Figure 2: Back-to-Back packet pair experiment

Now suppose the sender transmits two packets, each of size P bits (including headers), back-to-back to S_1. This means that the packets are transmitted one after another with no time gap between them (i.e. the last bit of first packet is immediately followed by first bit of second packet). Assume that there are no other packets in the network besides these two packets. The packets subsequently get forwarded by S_1 to S_2 and then from S_2 to the receiver on the path shown.

Calculate the inter-arrival spacing of the two packets (time gap between the arrival of the first bit of the first packet and arrival of the first bit of the second packet) when they reach the receiver.