Assignment – Introductory Part

Attempt all questions.

Submit answers to any three (3) questions. Submission should be in pdf form with index number and question number clearly written. Late submissions will be subject to a mark penalty.

1. Consider a conventional analogue signal which is to be digitized and transmitted over a communications link.

   a. If the analogue signal is band limited to 5 MHz and is quantized at 12 bits/sample, what is the *minimum* data rate possible for the equivalent digitized signal? Why should it be called as the 'minimum' data rate? Assume an ideal noise free channel.

   b. Suppose now the digitized signal of (a) is to be sent over a channel of 5 MHz bandwidth with a signal to noise ratio of 20dB. Can it be done? If not, what is the maximum bits/sample quantisation that will be allowed on this channel?

2. (a) A data signal which has a baud rate (= samples per second) of 80kSamples/sec. is to be transmitted over a communication channel of 1MHz with a signal to noise ratio of 30dB. What is the maximum number of bits/sample quantisation allowed over the channel?

   (b) Now the data signal of (a) is encoded using a Manchester like encoding for easy clock recovery. What would be the new baud rate of the signal? What new bandwidth requirements would this signal have?

3. A communication channel employs a multiple access scheme to resolve access to it by several competing Poisson like data sources (senders).

   (i)   Why is a *static* channel access method not recommended in this scenario?
   (ii) State two commonly used *dynamic* channel access methods.
   (iii) Under heavy traffic, which of the two in (ii) would perform worse? Why?
   (iv) Under light traffic, which of the two in (ii) would perform better? Why?

4. Suppose a broadcast multi access channel (i.e., Aloha) is to be shared by many users for packet data communication. Full bandwidth is available to a successful user who acquires the channel at any given time. Aloha is a probabilistic multiple access method. In Aloha, as the total load increases, the carried load increases up to a point and then decreases. Explain with reference to the equation.

5. Suppose in Aloha, the time axis is divided into virtual time slots each of which is tau duration, where the beginning of each slot is known by all senders. A sender is only allowed to send at the beginning of a slot only. Considering the probability of zero collisions within a slot, derive an expression for the 'good throughput' S in terms of the total load G.

6. Two broad classes of traffic can be identified that run on data networks: real time 'streaming' traffic (i.e., traffic that require real time delivery guarantees like voice/video) and store-and-forward traffic (i.e., traffic that does not need such guarantees like typical data). When digitized and delivered, voice/video traffic is delay sensitive (that is, it needs real time guarantees) but it is not error sensitive; whereas data traffic such as web/database queries is error sensitive but not delay sensitive. Explain (a) which type of traffic can be *time division multiplexed* and which type of traffic can be *statistically time division multiplexed*? (b) Which type of traffic is typically characterized by a Poisson arrival process?