**JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY**

**Electronics and Communication Engineering**

**Digital Systems (18B11EC213)**

**Tutorial Sheet: 8**

**Q1. [CO5]** The output Signal to Quantization noise ratio in a PCM system is defined as the ratio of average signal power to average quantizing noise power. For a full scale sinusoidal modulating signal with amplitude ***A***, show that

SNRq(dB) = 1.76 + 20 log L

**Q2. [CO5]** A television signal (video and audio) has a bandwidth of 4.5 MHz. This signal is sampled, quantized, and binary coded to obtain a PCM signal.

* Determine the sampling rate if the signal is to be sampled at a rate 20% above the Nyquist rate.
* If the samples are quantized into 1024 levels, determine the number of binary pulses required to encode each sample.
* Determine the binary pulse rate (bits per second) of the binary–coded signal, and the minimum bandwidth required to transmit this signal.

**Q3. [CO5]** The bandwidth of an input signal to the PCM is restricted to 4 kHz. The input signal varies in amplitude from -3.8V to +3.8V and has the average power of 30mW. The required signal to noise ratio is given as 20dB. The PCM modulator produces binary output. Assuming uniform quantization

* Find the number of the bits required per sample.
* Outputs of 30 such PCM codes are time multiplexed. What would be the minimum required transmission BW for this multiplexed signal?

**Q4. [CO5]** A signal having BW 4 kHz is sampled at 1.25 times of the Nyquist rate, the maximum quantization error while converting to binary PCM is 0.2% of the peak value. Find:

* Transmission rate
* BW of required channel
* If 25 such signal is time division multiplexed what will be the required BW.

**Q5. [CO5]:** A binary sequence 1100100010 is applied to the following transmitters, draw their output waveforms

(a) ASK

(b)BFSK

(c) BPSK

**Q6. [CO5]:** Determine the minimum bandwidth necessary to pass 10kbps binary signal using

ASK.

**Q7. [CO5]:** Determine the minimum bandwidth requirement for BFSK signal with a mark

frequency of 49 kHz, a space of 51 kHz and an input bit rate of 2kbps.

**Q8. [CO5]:** For a BPSK modulator with carrier frequency of 70MHz and an input bit rate of 10Mbps determine the minimum bandwidth of BPSK signal.