Homework Assignment
200 Points

1- (a) Using **Matlab** draw $\sin(4\pi t + \pi)$ for $t = [-0.5\ +0.5]$. Draw the same signal if the phase was zero.

2- Decompose $(1 + 0.1 \cos 5t) \cos 100t$ into a linear combination of sinusoidal functions. Find the amplitude, phase, and frequency of each component. Use the trig. identities.

3- a) Suppose that a digitized TV picture is to be transmitted from a source that uses a matrix of 480x500 picture elements (pixels), where each pixel can take one of 32 intensity values. Assume that 30 pictures are sent per second. Find the source data rate R (bps).

b) Assume that the TV picture is to be transmitted over a channel with 4.5 MHz bandwidth and 35 dB signal-to-noise ratio. Find the capacity of the channel (bps).

4- Given a channel with an intended capacity of 20 Mbps, the bandwidth of the channel is 3 MHz. Assuming white thermal noise, calculate the SNR required to achieve this capacity.

5- An amplifier has an output power of 20W. What is its output in dBW?

6- For the bit stream 01001110, sketch the waveform for each of the following codecs: NRZ-L, NRZI, Bipolar-AMI, Manchester, Differential Manchester, B8ZS. Assume that the signal level for the preceding bit for NRZI was high, the most recent preceding bit (AMI) has a negative voltage; and the most recent preceding 0 bit has a negative voltage.

7- The bipolar-AMI waveform representing the binary sequence of 0100101011 is transmitted over a noisy channel. The received waveform is detected as follow: **0,+5V, 0, 0, -5V, 0, -5V, 0, -5V, +5V**. What can you tell about the received waveform? If there is any error, locate its position. Can it be corrected?

8- A signal is quantized using 1-bit PCM. Find its signal-to-quantization noise ratio.

9- Consider an audio (analog) signal with spectral components in the range 300 to 3000 Hz. Assume that a sampling rate of 7000 samples per second will be used to generate a PCM signal. (a) To achieve SNR = 30 dB, what is the number of quantization levels needed? (b) What is the resultant data rate of this signal?

10 - Given the quantization levels in the following figure, write down the PCM output levels (for t=0-4 [sec]) of the presented signal. Sign bits: + is 0, - is 1. Sampling times Ts = 1 [sec].
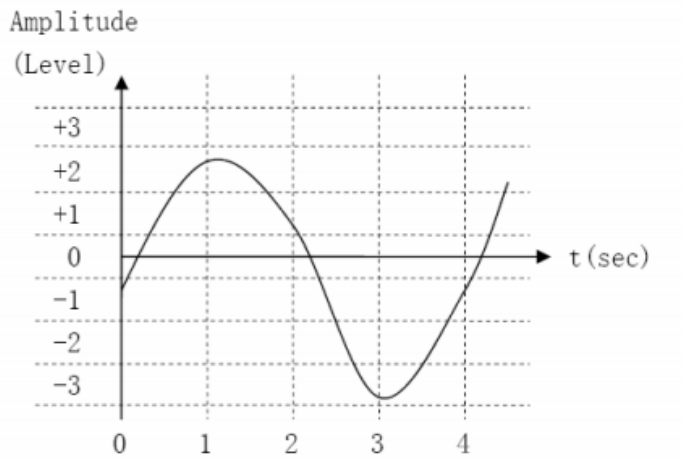
11- (a) Write down an equation describing the signal below as a function of time. (b) Use Matlab and plot your equation. (c) Plot the frequency spectrum of the following signal. In your plot remember that the ratio of amplitudes of different frequency components is reflected in the frequency spectrum.