Başkent University Electrical & Electronics Engineering Department
EEM 442 – Communication Systems II 1st Midterm

Duration: 90 mins 29/04/2002

1. Fig.1 shows the idealized spectrum of a message signal m(t). The signal is sampled at a rate equal to 1 kHz using flat-top pulses, with each pulse being of unit amplitude and duration 0.1 ms. Determine and sketch the spectrum of the resulting PAM signal.

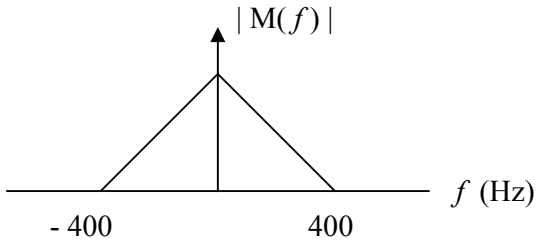

Fig.1

2. A linear delta modulator is designed to operate on speech signals limited to 3.4 kHz. The specifications of the modulator are as follows:

- Sampling rate = 10 $f_{Nyquist}$, where $f_{Nyquist}$ is the Nyquist rate of the speech signal.
- Step size Δ = 100 mV.

The modulator is tested with a 1 kHz sinusoidal signal. Determine the maximum amplitude of this test signal required to avoid slope overload.

3. A continuous-time signal is sampled and then transmitted as a PCM signal. The random variable at the input of the decision device in the receiver has a variance of 0.01 volts^2.

(a) Assuming the use of NRZ signalling, determine the pulse amplitude that must be transmitted for the average error rate not to exceed 1 bit in 10^8 bits.
(b) If the added presence of interference causes the error rate to increase to 1 bit in 10^6 bits, what is the variance of the interference?

4. The scheme shown in Fig.2 may be viewed as a differential encoder (consisting of the modulo-2 adder and the 1-unit delay element) connected in cascade with a special form of correlative coder (consisting of the 1-unit delay element and summer). A single delay element is shown in Fig.2 since it is common to both the differential encoder and the correlative coder.

(a) Find the frequency response and impulse response of the correlative coder part of the scheme shown in the Fig.2.
(b) Show that this scheme may be used to convert the on-off representation of a binary sequence (applied to the input) into the bipolar representation of the sequence at the output. You may illustrate this conversion by considering the sequence 010001101.

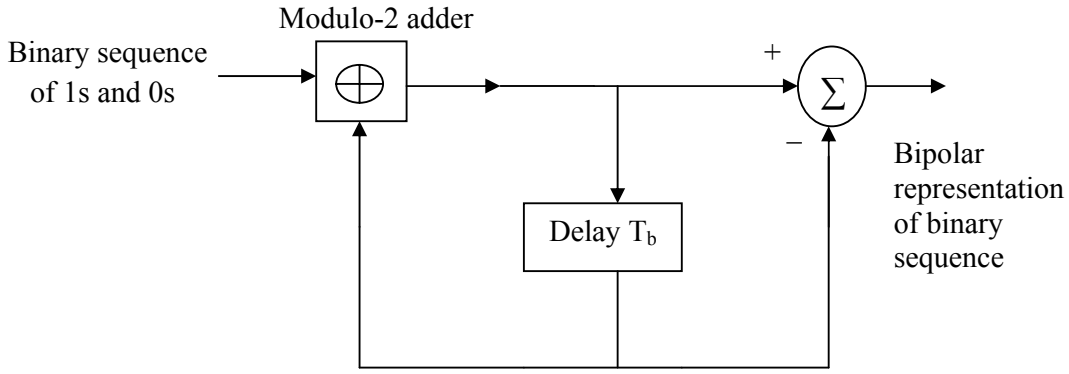

Fig.2