Review Questions - Fall 2015

Question 1

Draw the Block Diagram of the following:

1) DSB-LC Modulator
2) Non-coherent Demodulator for DSB-LC (write the conditions for proper operation)
3) Coherent Demodulator for DSB-LC (write the effect of phase and frequency synchronization errors)
4) DSB-SC Modulator
5) DSB-QAM Transmitter (write the composite output signal)
6) DSB-QAM Receiver (write expressions for the output signals)
7) SSB-SC Modulator using Hilbert Filter (write expressions for the output signal)
8) Narrow-Band Frequency demodulator
9) Wide-Band Phase modulator
10) FM Stereo Transmitter (draw the composite spectrum)
11) PCM system (write briefly the function of each block)
12) TDM system

Question 2

An angle modulated signal with carrier frequency ω_c is described by

$$s(t) = 2\cos(\omega_c t + 0.1\cos(200t))$$

1) What is the power of the modulated signal?
2) What is the maximum frequency deviation Δf?
3) What is the FM modulation index β?

Question 3

In a PCM system, the range of the input signal is ± 5 volts. It is required to design a uniform quantizer with a maximum quantization error of 0.4 volts.

1) What is the minimum number of bits required to characterize the output levels?
2) What is the actual maximum quantization error if that minimum number of bits are fully utilized?
3) Repeat parts 1) and 2) if the required maximum quantization error is 0.3 volts.

Question 4

A PCM uses a uniform quantizer followed by a 7-bit binary encoder. The bit rate of the system is equal to 50×10^6 bits/second. What is the maximum message bandwidth for which the system operates satisfactorily?

Question 5

A sinusoidal signal, with an amplitude of 3.25 volts is applied to the following quantizers. For each case sketch the waveform of the resulting quantizer output for one complete cycle of the input. Assume that 8 samples are taken per cycle.

1) Uniform quantizer whose output levels are $0, \pm 1, \pm 2, \pm 3$ volts.
2) Uniform quantizer whose output levels are $\pm 0.5, \pm 1.5, \pm 2.5, \pm 3.5$ volts.

Question 6

The system shown in Fig. 1 shows a sampling system that uses an alternating-sign train of impulses, followed by a filter. The FT of the input signal as well as the filter are shown in Fig. 1.

1) For $\Delta < \frac{\pi}{2\omega_m}$, sketch the FT of $x_p(t)$ and $y(t)$.
2) For $\Delta < \frac{\pi}{2\omega_m}$, determine a system that can recover $x(t)$ from $x_p(t)$.
3) For $\Delta < \frac{\pi}{2\omega_m}$, determine a system that can recover $x(t)$ from $y(t)$.
4) What is the maximum value of Δ as a function of ω_m such that $x(t)$ can be recovered from $x_p(t)$ or $y(t)$.

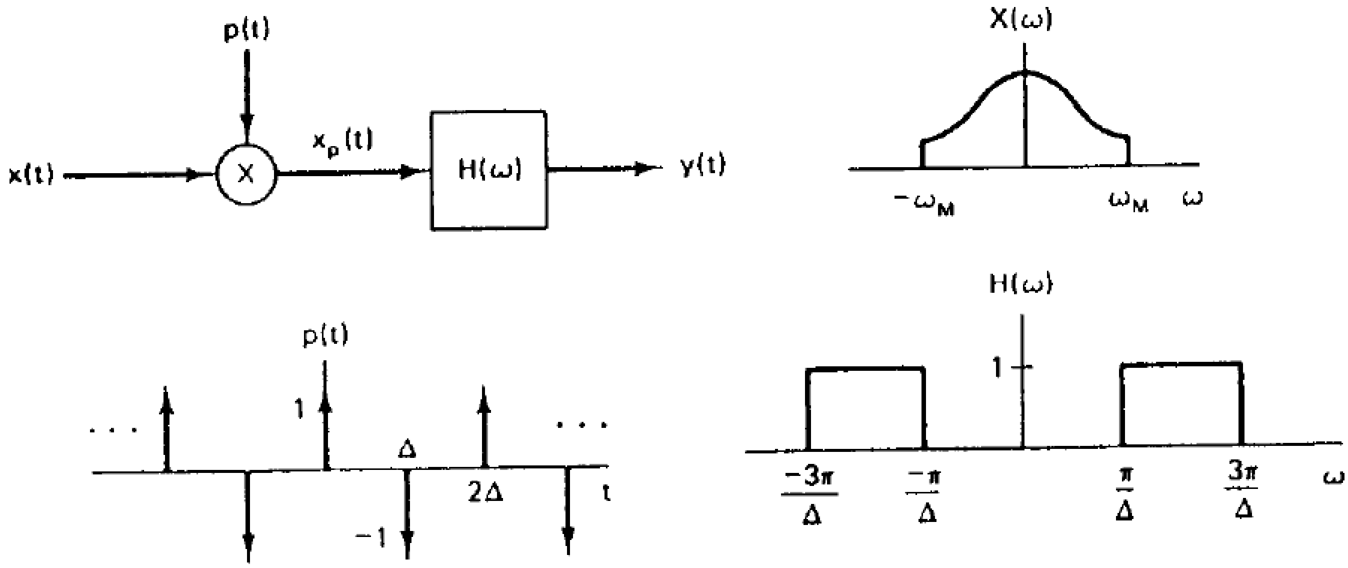

Fig. 1

Question 7

Fig. 2 shows the FT of a message signal $m(t)$. The signal is sampled at a rate of 1 KHz using a train of pulses with unit amplitude and duration of 0.1 ms.
Determine and sketch the FT of the resulting PAM signal.

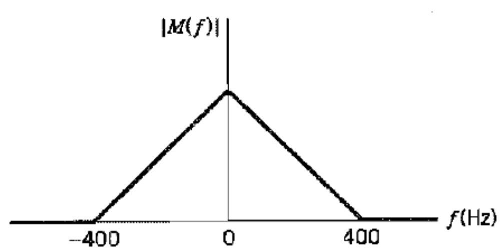

Fig. 2