**ENGR 4323/5323: Digital and Analog Communications**

**Test 1 (2/26/19)**

**Time:** 75 minutes **Name:**

t

Fig. 2

1

2

*g*(*t*)

*t*

1

2

*x*(*t*) = 2e-2t

Fig. 1

*x*(*t*)

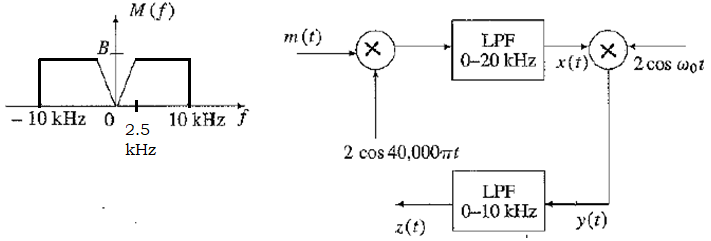
**1-20pts)** Find the correlation coefficient *ρ* between the signal *x*(*t*) and *g*(*t*) shown in Fig. 1 and Fig. 2.

**2-20pts)** Find the Fourier transform of the signal *x*(*t*) shown in Fig. 1.

**3-20pts)** For the system shown in Figure below.

a) Graphically find and show the spectra of signals *x*(*t*), *y*(*t*), and *z(t*) when ωo = 40,000π.

b) Find the energy of the signal *m*(*t*).



**4-20pts)** A transmission channel is modeled by the impulse response *h*(*t*)= *e-3t u*(*t*).

1. Find the transfer function *H*(*s*) and the frequency response *H*(*ω*).
2. Find the received signal *y*(*t*) if the transmitted signal is *x*(*t*) = 1 + 2δ(*t*- 2) – cos (4*t*). This is equivalent to finding the output *y*(*t*) of the system described by *h*(*t*) to the input *x*(*t*) = 1 + 2δ(*t*- 2) – cos (4*t*).

**5-20pts)** The input *x*(*t*)and the output *y*(*t*)of a certain nonlinear channel are related as

*y*(*t*)= *x*(*t*)+0.000158 *x*2(*t*)

Find the output signal *y*(*t*) and its spectrum *Y*(*f*) if the input signal is *x*(*t*) = 2000 *sinc*(2000*πt*). Verify that the bandwidth of the output signal is twice that of the input signal. Can the signal *x*(*t*) be recovered (without distortion) from the output *y*(*t*)? Explain your answer.