Name____ USF ID#__________________________

EEL 4512 – Introduction to Communication Systems

Fall 2006

Test 1 – October 23, 2006

Open Book/Open Notes

1 hour and 15 minutes

1. The exam is open-book/open-notes.

2. A calculator may be used to assist with the test. No laptops or PDAs are allowed.

3. You must circle or box your answers to get full credit.

4. All work and steps toward a solution must be clearly shown to obtain credit.

5. Partial credit may be given provided that the grader can clearly follow your work to the extent that an understanding of the problem is demonstrated.

6. No collaboration is allowed on this examination. Only Charles Baylis may be consulted for clarification.

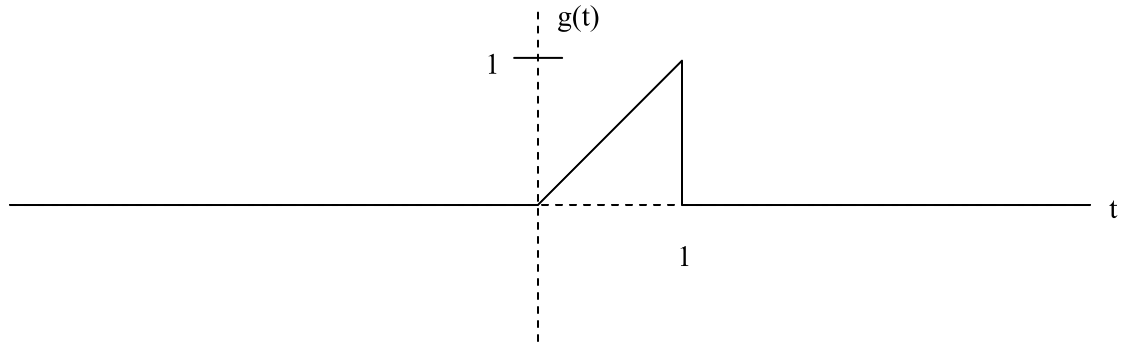
7. You may attach extra sheets to the exam if necessary. Each page should contain your name, the problem number, and the page number for that problem.

Please sign the statement below. YOU MUST SIGN THE STATEMENT OR YOU WILL GET A ZERO FOR THIS EXAMINATION!!!

I hereby testify that I have neither provided or received information during the test and that this test is the sole product of my effort.

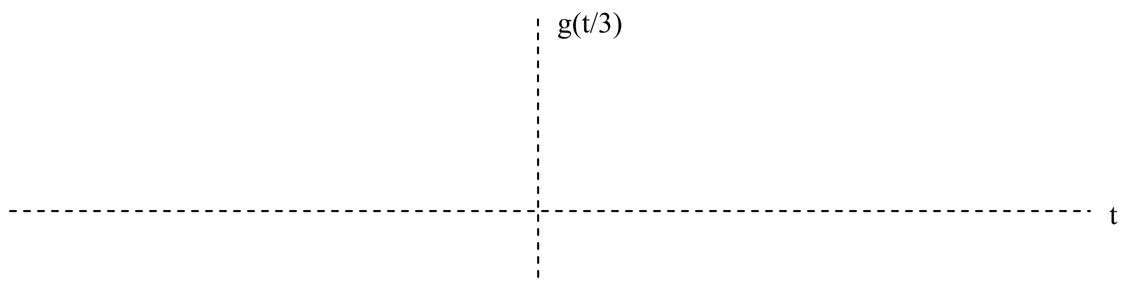
Signed ____ Date______________________

PROBLEM 1 (15 points): Consider the following signal g(t):



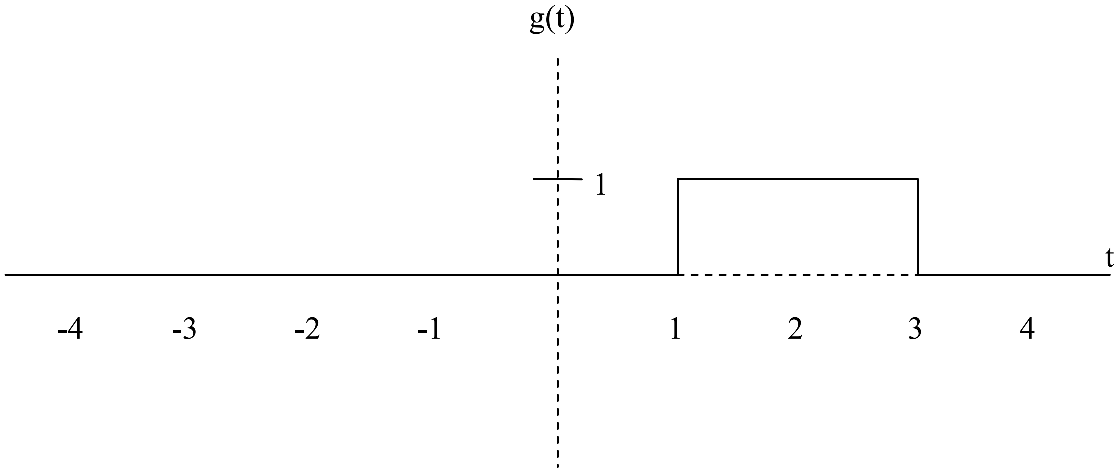
(a) Calculate the energy of g(t) (5 points).

(b) Draw the signal g(t/3), clearly indicating all axis crossing points and amplitudes (5 points).



(c) Are the signals m(t) = 6t and n(t) = 3 orthogonal over the interval $0 < t < 1$? Use the definition of signal orthogonality to prove your answer (5 points).

PROBLEM 2 (20 points): Consider the function



(a) (12 points) Find an expression for the Fourier transform of g(t), that is, G(ω) (Use a Fourier transform table along with appropriate properties of the Fourier transform).

(b) (8 points) Find an expression for the Fourier transform of f(t) = g(t) cos (500t).

PROBLEM 3 (20 points): Consider a system with transfer function

$$H(\omega) = rect(\omega / 20{,}000\pi)$$

The function

$$g(t) = 5000 \text{ rect } (5000t)$$

is input to the system.

(a) (10 points) Find an expression for G(ω) and sketch it (it will be real, so plot magnitude only). Indicate critical amplitudes and important zero crossings.

(b) (10 points) Using your knowledge of G(ω) and H(ω), find and sketch Y(ω).

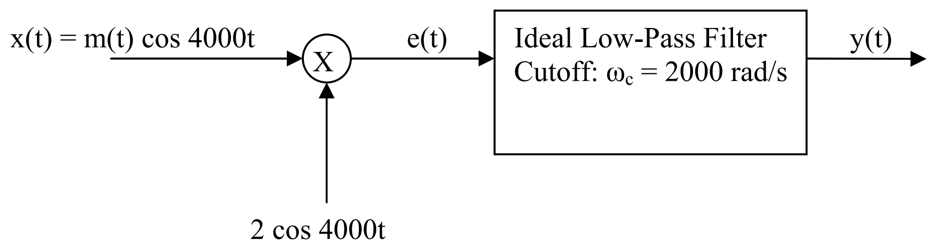
PROBLEM 4 (25 points): Consider the baseband signal

$$m(t) = \frac{1000}{2\pi} \operatorname{sinc}^2(500t)$$

(a) Sketch the spectrum of m(t); that is, M(ω). Label important frequencies and amplitudes (5 points).

(b) Sketch the spectrum of the DSB-SC signal $x(t) = m(t)\cos 4000t$. Label important frequencies and amplitudes (8 points).

Assume that the transmitted signal $x(t) = m(t) \cos 4000t$ is the signal that enters the receiver demodulator shown below.



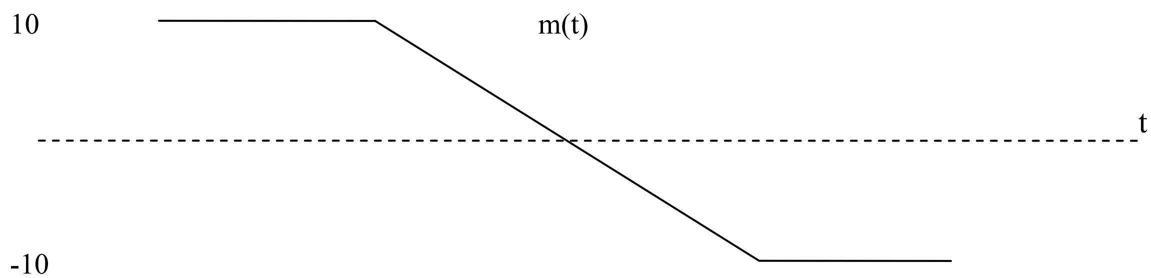
(c) Sketch the spectrum of e(t); that is, $E(\omega)$. Label important frequencies and amplitudes (8 points).

(d) Sketch the spectrum of y(t); that is, $Y(\omega)$. Label important frequencies and amplitudes (4 points).

PROBLEM 5 (20 points): Sketch the AM signal

$$[A + m(t)]\cos\omega_c t$$

for the message signal m(t) shown below for the listed values of the modulation index. For each case, state whether the message m(t) will be able to be completely recovered from the envelope.



(a) μ = 0.5 (5 points)

(b) μ = 1 (5 points)

(c) $\mu = \infty$ (5 points)

(d) Which, if any, of the above modulation indices represents AM Double-Sideband-Suppressed-Carrier (AM-DSB-SC) modulation (5 points)?