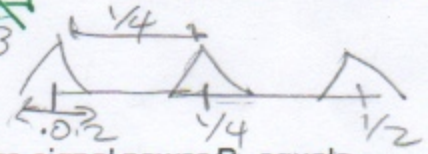
5 Points Each, *Circle the best answer*

1. The fundamental frequency the Fourier series of $x(t) = \sum_{n=-\infty}^{\infty} 3\Delta\left(\frac{t-n/4}{0.02}\right)$ is

a) 1/4 Hz b) 1/5 Hz c) 4 Hz d) 5 Hz e) 50 Hz f) none above



2. For a signal $g(t) = 5\cos(200\pi t) + \sin(400\pi t)$ the signal power P_g equals

a) 2 b) 4 c) 5 d) 9 e) 13 f) none above

$\left(\frac{5}{\sqrt{2}}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{25}{2} + \frac{1}{2} = 13$ $\frac{1}{T}\int (5\cos + \sin)^2 = \frac{1}{T}\int 25\cos^2 + \sin^2 + 5\sin\cos$

3. The bandwidth of the DSB-LC signal g(t) = [4+sin(10π t) +sin(40π t)] cos(10,000π t) is

a) 10 Hz b) 20 Hz c) 40 Hz d) 60 Hz e) 80 Hz f) none above

4. If x(t) = 4Π(4t) , the Fourier transform of x(t) is X(f) =

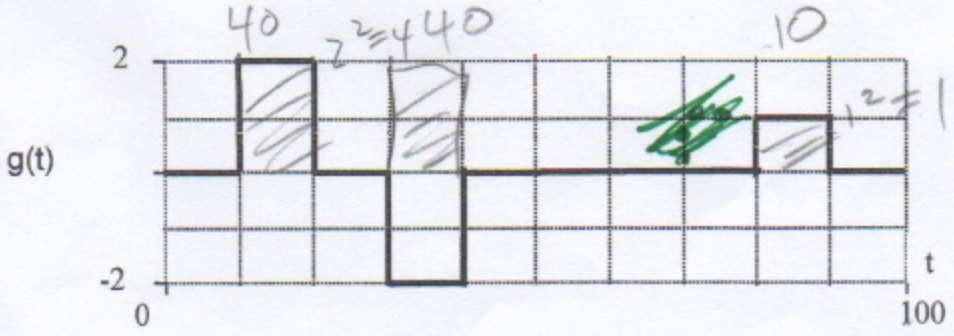
a) 2 sinc(πf/2) b) sinc(πf/2) c) sinc(πf/4) d) 2 sinc(πf/4) e) none above

$\Pi(t/\tau) \Leftrightarrow \tau\,\mathrm{sinc}(\pi f \tau)$

$4\Pi\left(\frac{t}{1/4}\right) \Rightarrow 4/4\,\mathrm{sinc}(\pi f/4)$

5. The energy of the signal g(t) shown below is

a) 40 b) 60 c) 90 d) 100 e) 120 f) none above



5 Points Each, Circle the correct answer

6. The system with impulse response $h(t)=\frac{1}{\pi t}$ has a frequency response H(f)=

a) 2/(jπf) b) -j sgn(f) c) j sgn(f) d) Δ(πf /2) + j Δ(-πf /2) e) none above

7. For the signal g(t) with Fourier transform $g(t) = e^{-40\pi t}u(t)$ the 3 dB bandwidth is

a) 10 Hz b) 20 Hz c) 30 Hz d) 40 Hz e) none above

8. In the exponential Fourier series expansion of the signal g(t) where

$g(t) = \sum_{n=-\infty}^{\infty} 5\Pi\left(\frac{t}{2} - 10n\right)$, the term D_0 =

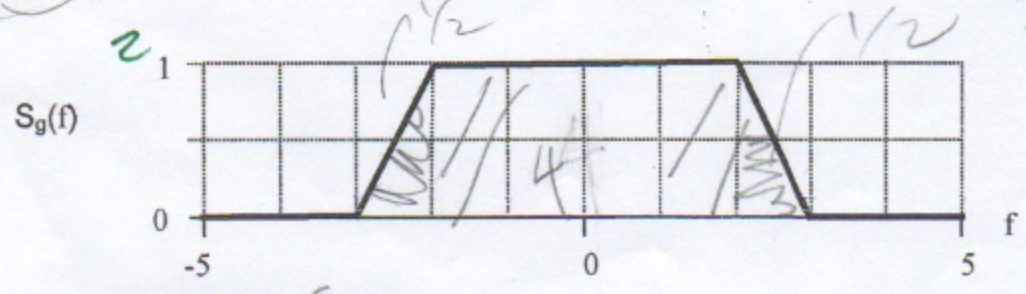
a) 1/5 b) 1/4 c) 1/2 d) 1 e)2 f) none above

9. For a system with frequency response $G(f) = \Delta(f)\, e^{-j\pi f/2}$, the group delay near 0 Hz is

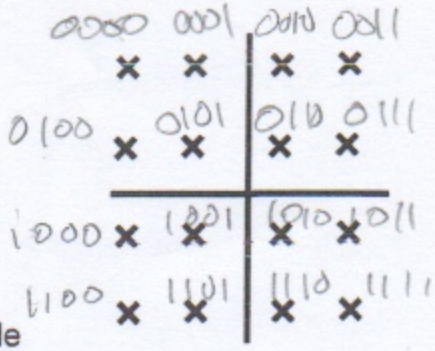
a) 0.25 s b) 0.5 s c) 2 s d) 4 s e) none above

10. For a system with power spectral density $S_g(f)$ below, the signal power is P_g=

a) 5 b) 10 c) 15 d) 20 e) 40 f) none above



5 Points Each, Circle the correct answer

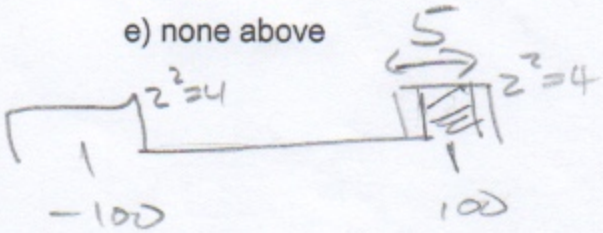


11. A QAM modulator with the constellation diagram above can encode

a) 4 bits b) 3 bits c) 2 bits d) 1 bit e) none above

12. For a signal g(t) with energy spectral density $\Psi_g = 2\Pi(f/5 + 20) + 2\Pi(f/5 - 20)$, the essential bandwidth containing 80% of the energy is B_{80}=

a) 40 Hz b) 12 Hz c) 8 Hz d) 4 Hz e) none above



13. A cube root of -j/2 is

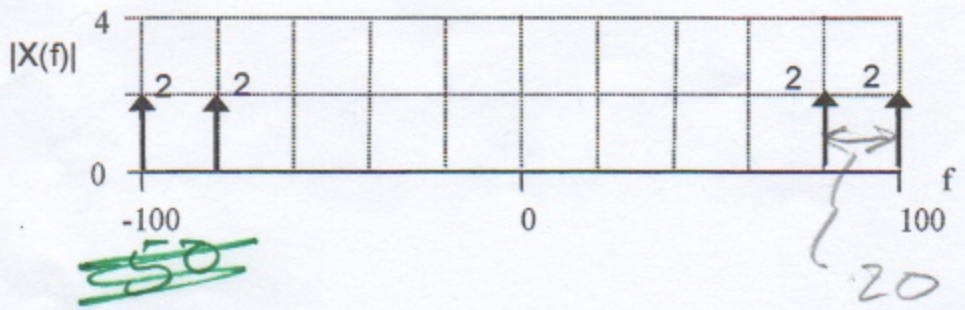
a) $e^{j\pi}$ b) $e^{j\pi/6}$ c) $e^{j\pi/9}$ d) none above

14. For a DSB-LC signal with modulation index μ = 3/4, the power efficiency is η =

a) 15% b) 20% c) 33% d) none above

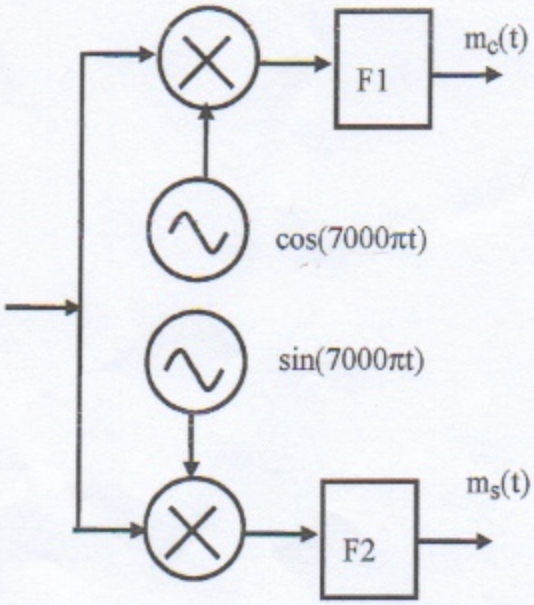
15. For a DSB-SC signal x(t) having |X(f)| below, the *modulation* frequency is

a) 5 Hz b) 10 Hz c) 15 Hz d) 20 Hz e) none above



Points Each, circle the best answer

$f(t) = 2\cos(100\pi t)\cos(7000\pi t) - 4\sin(7000\pi t)$



In the system above with input f(t) and with outputs $m_c(t)$ and $m_s(t)$, filters F1 and F2 are ideal lowpass filters with bandwidth 200 Hz.

16. For the *system above*, the top output is $m_c(t)$=

a) 2 b) $2\,e^{j\,100\pi t}$ c) cos(100πt) d) sin(100πt) e)none above

17. For the *system above*, the bottom output is $m_s(t)$=

a) -2 b) $-4\,e^{j\,100\pi t}$ c) 2 cos(100πt) d) -4 sin(100πt) e)none above

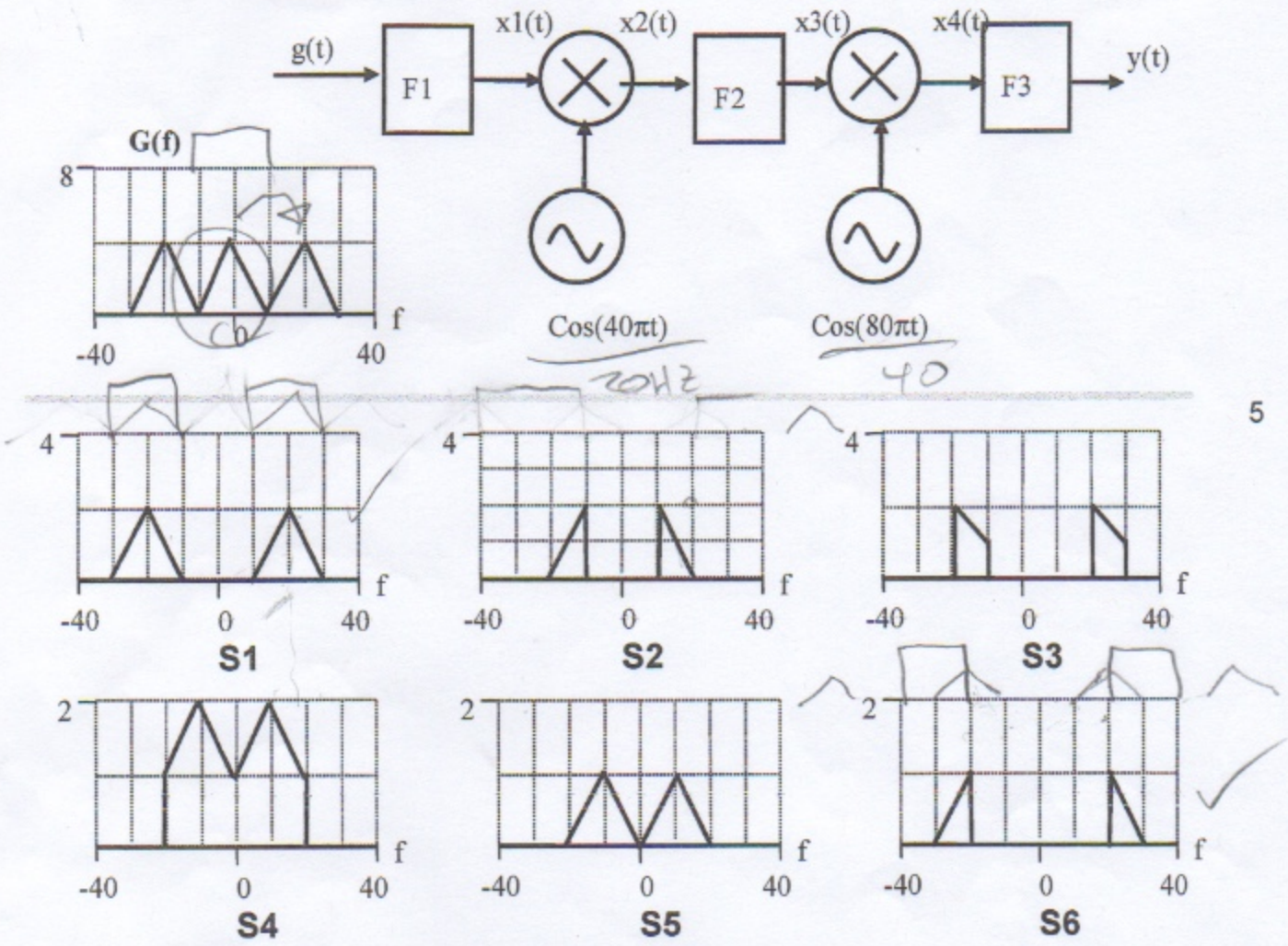
18. An envelope detector can be best used to demodulate

a) DSB-LC b) SSB c) USB d) DSB-SC

19. The inverse Fourier transform of the power spectral density $S_g(f)$ is the autocorrelation $R_g(\tau)$.

a) True b) False

The following questions refer to the system below having input g(t) with spectrum G(f).
F1 is an ideal lowpass filter with bandwidth 10 Hz
F2 is an ideal bandpass filter with bandwidth 20 Hz and center frequency 20 Hz
F3 is an ideal bandpass filter with bandwidth 20 Hz and center frequency 30 Hz.



5

Points Each, Circle the correct answer

20. The magnitude of the frequency spectrum of |X2(f)| is

a) S1 b) S2 c) S3 d) S4 e) None above

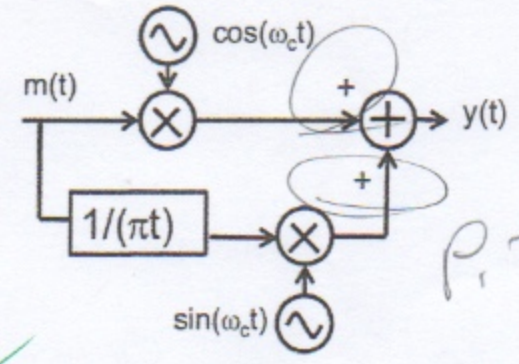
21. The magnitude of the frequency spectrum of |X3(f)| is

a) S1 b) S3 c) S5 d) S6 e) None above

22. The magnitude of the frequency spectrum of |Y(f)| is

a) S3 b) S4 c) S5 d) S6 e) None above

5 Points Each, Circle the correct answer



LSB

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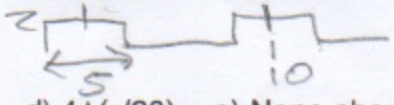
23. In the radio transmitter above with input m(t), the modulation of y(t) is best described as

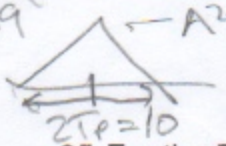
a) DSB-SC b) USB c) LSB d) QAM e) VSB

24. For the signal $g(t) = \sum_{n=-\infty}^{\infty} a_n \Pi\left(\frac{t-10n}{5}\right)$ where a_n is random, and is either -2 or 2, the autocorrelation is $R_g(\tau)$ =



a) 2Δ(τ/5) b) 4Δ(τ/2) c) 2Δ(τ/10) d) 4Δ(τ/20) e) None above

$R_g(\tau)$ $A^2 T_p / T_0 = 2^2 \cdot 5/10 = 2$



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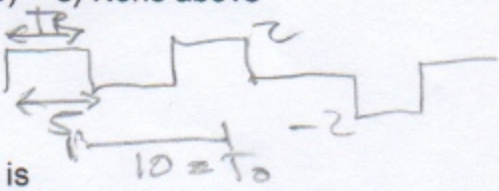
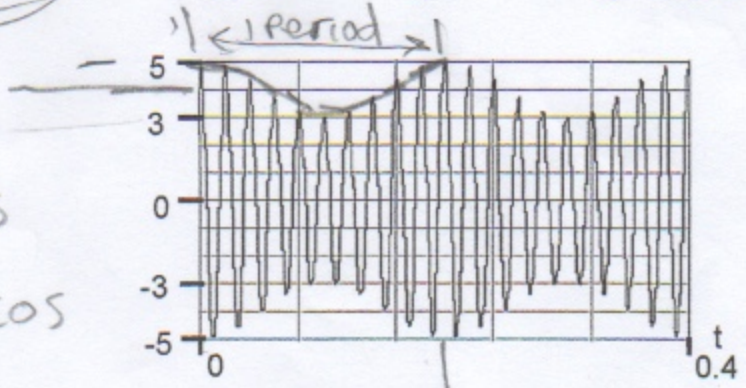


25. For the DSB-LC time waveform below, the modulating frequency is

a) 5 Hz b) 10 Hz c) 15 Hz d) 20 Hz e) none above

26. For the DSB-LC time waveform below, modulation index is

a) 0.125 b) 0.25 c) 0.5 d) 1 e) none above



$A = 4$

$\Rightarrow (4 + 1\cos(\omega t))\cos$

$= 4\left(1 + \frac{1}{4}\cos(\omega t)\right)\cos$

0.2

Or $\frac{|M(t)|_{PEAK}}{A} = \frac{1}{4}$

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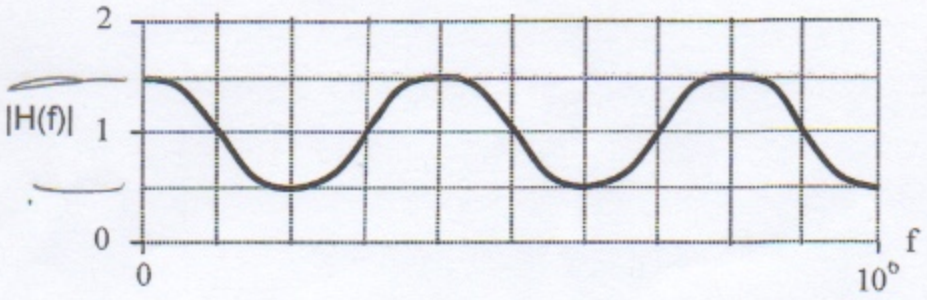
5 Points Each,
circle the best answer



27. For the multipath frequency response |H(f)| above, the attenuation factor for the delayed signal is α =

a) 0.25 b) 0.5 c) 0.75 d) d) None above

28. The bandwidth of QAM signal g(t)= cos(50πt) sin(4000πt) + cos(100πt) cos(4000πt) is

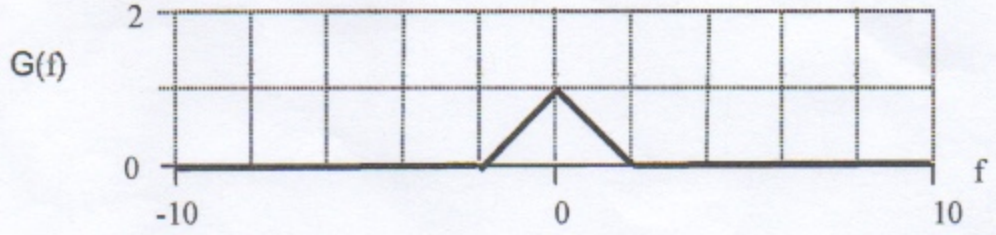
a) 50 Hz b) 100 Hz c) 150 Hz d) 200 Hz e) none above

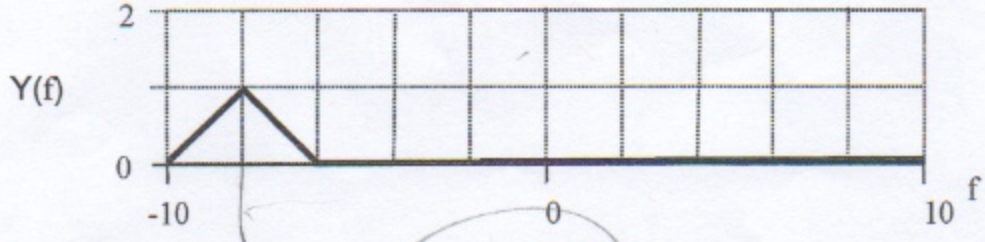
29. The Hilbert transform of 2 cos(πt) is

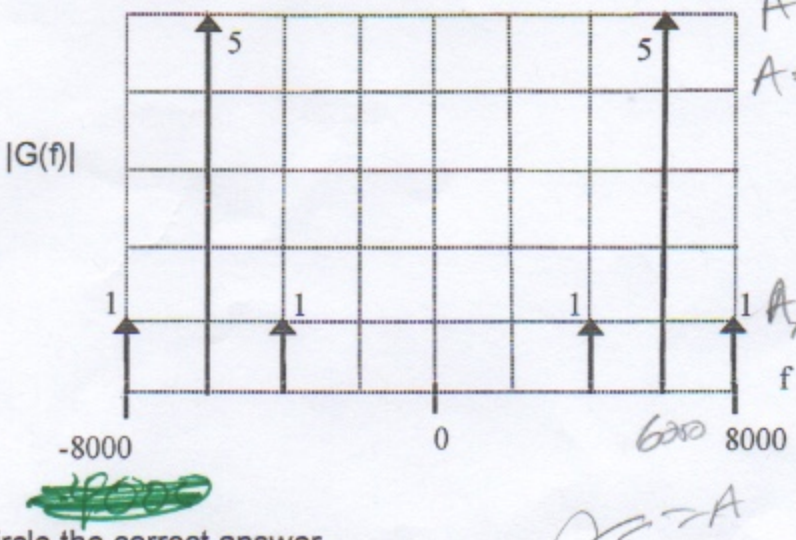
a) -2j cos(πt) b) 2 cos(πt) c) 2 sin(πt) d) -2 sin(πt) e) none above

30. Given G(f) below is the Fourier transform of g(t), then spectrum of Y(f) below is for y(t) =

a) g(t) $e^{j4\pi t}$ b) g(t) $e^{-j4\pi f}$ c) g(t) $e^{j8\pi t}$ d) g(t) $e^{-j8\pi t}$ e) None above







Note: Spectral line amplitudes not necessarily drawn to scale

5 Points Each, Circle the correct answer

The following questions refer to the DSB-LC signal $g(t)=(B + C\cos(2\pi f_m t))\cos(2\pi f_c t)$, with modulation index μ, carrier frequency f_c, and sinusoidal modulating signal m(t) with modulation frequency f_m, and magnitude |G(f)| as given above.

31. The modulation index μ is

a) 1/10 b) 1/5 c) 1/3 d) 2/5 e) None above

32. The carrier frequency f_c is

a) 2000 Hz b) 3000 Hz c) 4000 Hz d) 6000 Hz e) None above

33. The modulating frequency f_m is

a) 250 Hz b) 500 Hz c) 1000 Hz d) 2000 Hz e) None above

34. The carrier amplitude B in the *time-domain* signal equation above is

a) 4 b) 5 c) 10 d) 20 e) None above

35. The power in each sideband is how many dB below the carrier power?

a) 6 dB b) 12 dB c) 14 dB d) 23 dB e) None above