# ECE 461/561: Communication Systems Design (I)

Winter 2007                        Name:

Quiz 2                          ID#:

1. (6 pts) Given that $f(t)$ is a single-tone signal $-4 < f(t) < 4$, for DSB-LC amplitude modulation, please determine the following:

    (a) $A$ of the large carrier for maximum power efficiency of transmission; $A = $ ———

    (b) Using result from (a) above, the AM modulation index $m$; $m = $ ——

    (c) Using result from (b) above, the power efficiency of transmission
        (ratio of power in sideband over total power) $\mu$. $\mu = $ ——

    (d) the power efficiency of transmission if using DSB-SC Amplitude Modulation
        for the same modulating signal without a pilot carrier $\mu$. $\mu = $ ———

2. (6 pts) For $f(t) = \sin \omega_m t$ find $\hat{f}(t)$ such that $z(t) = f(t) + j\hat{f}(t)$ is the analytic signal.

$$\hat{f}(t) = - - - - - - - - $$

If $\cos \omega_c t$ is used as the carrier, give the expression of SSB-SC signal $\phi_{SSB-}$.

$$\phi_{SSB-} = - - - - - - - - $$

If $\cos \omega_c t$ is used as the carrier, give the expression of SSB-LC signal $\phi_{SSB+}$.

$$\phi_{SSB+} = - - - - - - - - $$

3. (8 pts) A signal $f(t)$ has its Fourier Transform $F(\omega)$ as

$$F(\omega) = \begin{cases} 10K & \text{for} \quad |\omega| \leq 10K \ rad/s \\ 20K - \omega & \text{for} \quad 10K \leq |\omega| \leq 20K \ rad/s \\ 0 & \text{for} \quad |\omega| > 20K \ rad/s \end{cases}$$

(a) Sketch the magnitude of the Fourier Spectrum $|F(\omega)|$

—————————————————

$|F(\omega)|$

(b) Calculate its *Half-Power Bandwidth*

$W_{HP} =$ —————

(c) Calculate its *Noise Equivalent Bandwidth*

$W_{eq} =$ —————

(d) Calculate the lowest sampling frequency to this signal without aliasing.

$w_s =$ —————

4. (5 pts) Determine if the following functions are periodic. If periodic, find the period; if not periodic, state the reason.

(a) $f(t) = \sin(\pi)^2 t + \sin \pi t$       Yes: ———, No: ——— Period or reason:

(b) $f(t) = \sin \sqrt{3}\pi t + \sin \pi t$       Yes: ———, No: ——— Period or reason:

(c) $f(t) = (\sin \pi t)^2 + \sin \pi t$       Yes: ———, No: ——— Period or reason:

(d) $f(t) = (\sin t)^2 + \sin \pi t$       Yes: ———, No: ——— Period or reason:

(e) $f(t) = \cos 2\pi t + \sin \pi t$       Yes: ———, No: ——— Period or reason:

5. (0 pts) Comments:

Have fun!

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