Electrical Engineering and Computer Science
Syracuse University

ELE 551, Fall 2010

# Homework #7

Due on **November 4, 2010, Thursday** In Class

1. [10 points] (L&D Exercise 5.2-3) For a message signal

$$m(t) = 2\cos 1000t + 9\cos 2000\pi t$$

(a) Write expressions (do not sketch) for $\varphi_{PM}(t)$ and $\varphi_{FM}(t)$ when $A = 10$, $w_c = 10^6$, $k_f = 1000\pi$, and $k_p = 1$.
(b) Estimate the bandwidths of $\varphi_{FM}(t)$ and $\varphi_{PM}(t)$.

2. [10 points] (L&D Exercise 5.2-4) An angle-modulated signal with carrier frequency $w_c = 2\pi \times 10^6$ is described by the equation

$$\varphi_{EM}(t) = 10\cos(w_c t + 0.1\sin 2000\pi t)$$

(a) Find the power of the modulated signal.
(b) Find the frequency deviation $\Delta f$.
(c) Find the phase deviation $\Delta\phi$.
(d) Estimate the bandwidth of $\varphi_{EM}(t)$.

3. [10 points] (L&D Exercise 5.2-6) Estimate the bandwidth for signals $\varphi_{PM}(t)$ and $\varphi_{FM}(t)$ in problem 2 of Homework 6. Assume the bandwidth of $m(t)$ to be the third-harmonic frequency of $m(t)$.

4. [10 points] (L&D Exercise 5.2-7) Given $m(t) = \sin 2000\pi t$, $k_f = 200,000\pi$, and $k_p = 10$.
(a) Estimate the bandwidths of $\varphi_{FM}(t)$ and $\varphi_{PM}(t)$.
(b) Repeat part (a) if the message signal amplitude is doubled.
(c) Repeat part (a) if the message signal frequency is doubled.
(d) Comment on the sensitivity of FM and PM bandwidths to the spectrum of $m(t)$.