

Introduction Communication Systems
Columbia University
ELEN E3701
Spring Semester- 2008

Problem Set # 4

Problems Due: 26 February 2008

Problems #1, 2 and 3

The following problems come from Haykin's Book.

Problems 2.22, 2.28 and 2.31

Problem #4

Write the equation for an SSB-FM signal, which only contains frequencies below the carrier frequency, f_0 . Assume that the baseband phase modulating signal is $\phi(t)$, as in class.

Problem #5

Suppose we have an FM signal where the modulating signal, $s(t)$, is made up of two frequencies

$$s(t) = A_1 \cos 2\pi W_1 t + A_2 \cos 2\pi W_2 t$$

- a. Write down the equation for the FM signal in terms of $\beta_1 = \Delta f_1 / W_1$ and $\beta_2 = \Delta f_2 / W_2$ where $\Delta f_1 = hA_1$ and $\Delta f_2 = hA_2$.
- b. Now represent the FM signals, as a double series, using the Bessel Functions $J_n(\beta_1)$ and $J_n(\beta_2)$.
- c. What is the maximum frequency deviation in terms of β_1 , β_2 , W_1 , W_2 , Δf_2 and/or Δf_1 ?
- d. What would be Carson's bandwidth in terms of β_1 , β_2 , W_1 , W_2 , Δf_2 and/or Δf_1 ?

THIS STARTS TO BE INTERESTING!!