

國立高雄大學 102 學年度研究所碩士班招生考試試題

科目：通訊系統
 考試時間：100 分鐘

系所：電機工程學系(通訊專業領域) 是否使用計算機：是
 本科原始成績：100 分

1. Hilbert Transform (30pts)

The Hilbert transform of a signal $x(t)$ is $\hat{x}(t) = \mathfrak{T}^{-1}[-j \operatorname{sgn}(f)X(f)]$ where $\operatorname{sgn}(f) = \begin{cases} 1, f > 0 \\ 0, f = 0 \\ -1, f < 0 \end{cases}$
 Assume that the Fourier transform of $x(t)$ is real and has the shape as shown in Figure 1. Determine and plot the spectrum of each of the following signals:

a) $x_1(t) = \frac{2}{3}x(t) + \frac{1}{3}j\hat{x}(t)$; b) $x_2(t) = \left[\frac{4}{3}x(t) + \frac{4}{3}j\hat{x}(t)\right]e^{j2\pi f_0 t}$; $f_0 \gg W$

c) $x_3(t) = \left[\frac{2}{3}x(t) + \frac{4}{3}j\hat{x}(t)\right]e^{j2\pi Wt}$; d) $x_4(t) = \left[\frac{2}{3}x(t) - \frac{2}{3}j\hat{x}(t)\right]e^{j\pi Wt}$

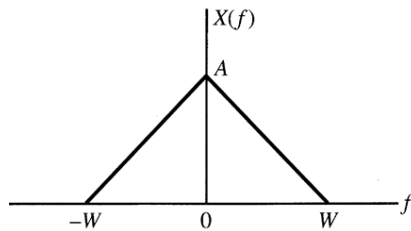


Figure 1

2. Amplitude Modulation (30pts)

Consider the system shown in Figure 2. Assume that the average value of $m(t)$ is zero and the maximum value of absolute $m(t)$ is M . Assuming the square law device is defined by

$$y(t) = 4x(t) + 2x^2(t)$$

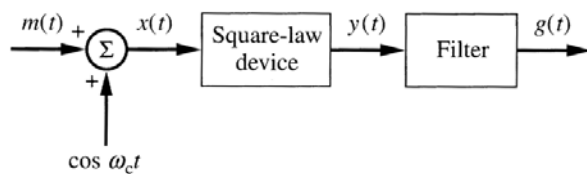


Figure 2

- Write the equation for $y(t)$ in terms of $m(t)$
- Describe the filter that yields an AM signal for $g(t)$.
 Give the necessary filter type and frequencies of interest.
- What value of M yields a modulation index of 0.2?
- Name an advantage of this method of modulation

3. Frequency Modulation (20pts)

A narrowband FM signal has a carrier frequency of 110 kHz and a deviation ratio of 0.05. The modulation bandwidth is 10 kHz. The signal is used to generate a wideband FM signal with a deviation ratio of 20 and a carrier frequency of 100 MHz. The scheme utilized to accomplish

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this is shown in Figure 3.

- a) Determine the required value of frequency multiplication, n .
- b) Also, fully define the mixer by giving two permissible frequencies for the local oscillator,
- c) and define the required bandpass filter (center frequency and bandwidth).

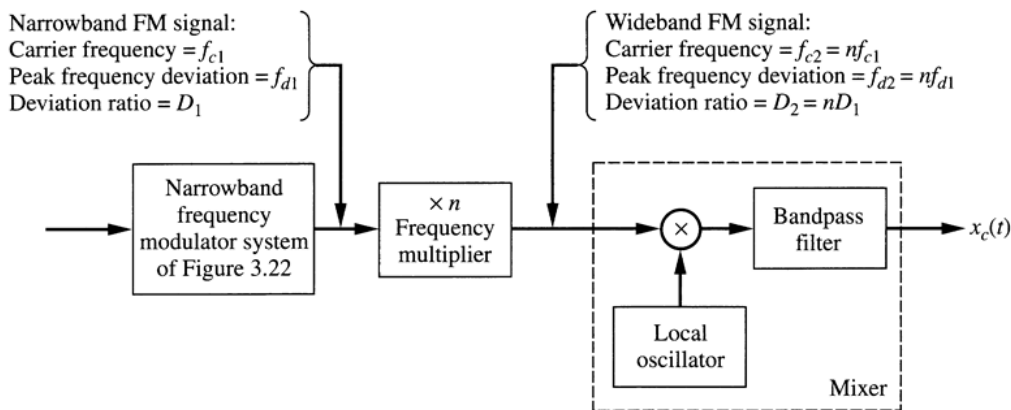


Figure 3

4. Phase Lock Loop-PLL (20pts)

The imperfect second-order PLL is defined as a PLL with the loop filter $F(s) = \frac{s + a}{s + \lambda a}$

in which λ is the offset of the pole from the origin relative to the zero location. In practical implementation λ is small but often cannot be neglected. Use the linear model of the PLL and derive the transfer function for $\Theta(s)/\Phi(s)$. Derive the expressions for ω_n and ζ in terms of K_t, a, λ

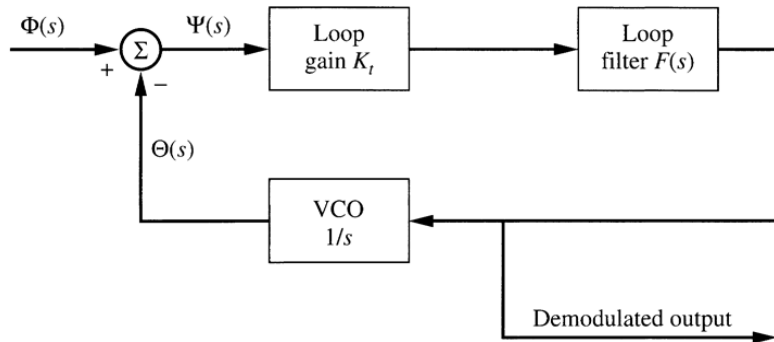


Figure 4