

科目	通訊系統	適用系所	通訊工程學系	時間	100 分鐘
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※請務必在答案卷作答區內作答。 共 2 頁第 1 頁

1. Let the spectrum of the signal $x(t)$ be denoted by $X(f)$. Suppose a signal $y(t)$ has the spectrum $Y(f)=2jX(f)\sin(2\pi ft_0)$, where t_0 is a constant. Please find the relation of $y(t)$ and $x(t)$. (10%)
 (Hint: $\mathcal{F}[\sin(2\pi ft_0)]=\frac{1}{2j}[\delta(f-f_0)+\delta(f+f_0)]$, $\mathcal{F}[\cdot]$ denotes Fourier transform)

2. A FM system is shown in Fig. P2. The output of VCO has modulation index β_0 and carrier frequency f_0 . There are three separate frequency multipliers with multiplication factors n_1, n_2 and n_3 . The mixer is of down-conversion. Suppose the FM signal is designated to be with carrier frequency f_c and modulation index β_f , write expressions of f_c and β_f in terms of $n_1, n_2, n_3, f_0, \beta_0$. (20%)

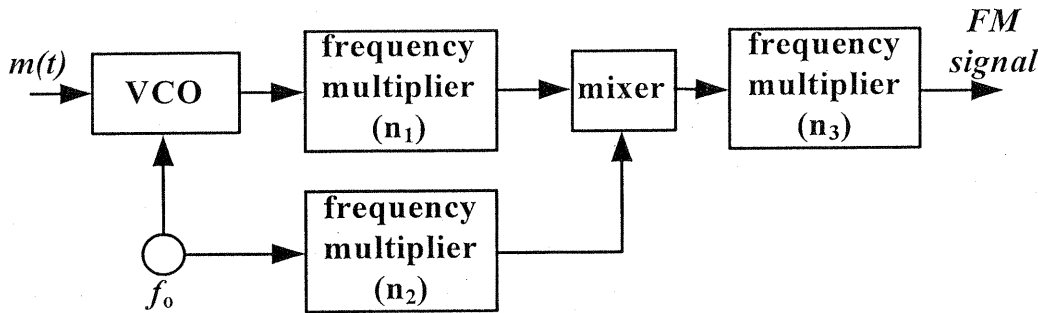


Fig. P2

3. The message signal $m(t)$ whose spectrum is shown in Fig. P3(a) is passed through the system shown in Fig. P3(b). The BPF in Fig. P3(b) is an ideal bandpass filter with bandwidth W centered at f_0 .
 (a) Please plot the spectrum of $x(t), y_1(t)$ and $y_2(t)$. (10%)
 (b) How can you recover $m(t)$ from $y_2(t)$. Explain your answer. (10%)

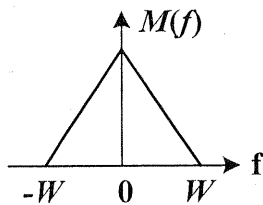


Fig. P3(a)

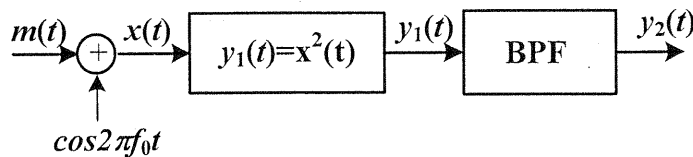


Fig. P3(b)

4. Find the noise-equivalent bandwidth of a lowpass RC filter. (10%)

5. The received signal in a binary communication system that employs antipodal signals is

$$r(t) = s(t) + n(t)$$

where $s(t)$ is shown in Fig. P5 and $n(t)$ is AWGN with power spectral density $N_0 / 2$ W/Hz.

- Sketch the impulse response of the filter matched to $s(t)$. (10%)
- Sketch the output of the matched filter to the input $s(t)$. (10%)
- Determine the variance at the noise of the output of the matched filter at $t = 3$. (10%)
- Determine the probability of error as a function of A and N_0 . (10%)

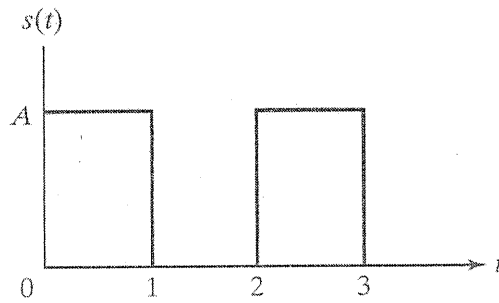


Fig. P5