

大同大學 九十一 學年度研究所碩士班入學考試題

考試科目：通訊原理

所別：通訊工程研究所

第1/2頁

註：本次考試不可以參考自己的書籍及筆記； 不可以使用字典； 可以使用計算器。

1. A block diagram of a mixer is given in Fig.1. Where $m(t)$ is a lowpass signal with a bandwidth of B .

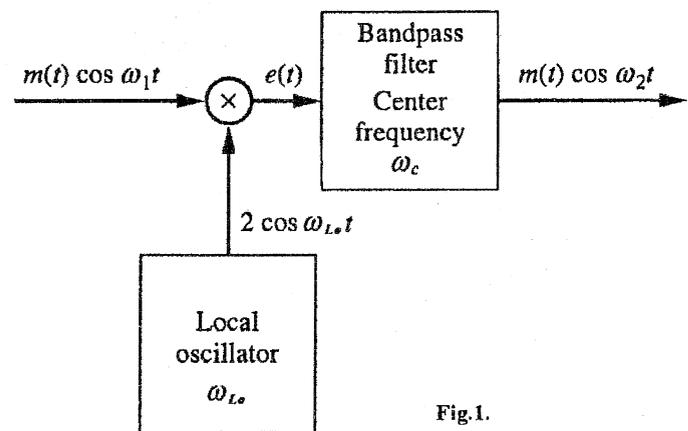


Fig.1.

- (a) Calculate the frequencies (ω_{Lo}) of the local oscillator for low-side and high-side tuning. (5%)
- (b) Calculate the corresponding *image frequencies*. (5%)
- (c) Give the center frequency (ω_c) and the minimum bandwidth required for the bandpass filter. (5%)

2. For the five channels that have the frequency responses as given by:

(i) $H_1(\omega) = A \cdot e^{j\omega^2}$. (ii) $H_2(\omega) = |A\omega^2| \cdot e^{j\omega^2}$. (iii) $H_3(\omega) = 2A \cdot e^{j2\omega}$

(iv) $H_4(\omega) = |A\omega| \cdot e^{j\omega}$. (v) $H_5(\omega) = A/2 \cdot e^{j\omega/2}$ (A is constant)

- (a) Choose the channels that are all-pass system. (3%)
- (b) Choose the channels that have constant envelope delay. (3%)
- (c) Choose the channels that have constant group delay. (3%)
- (d) Choose the channels that have constant phase delay. (3%)
- (e) Choose the channels that are transmission distortionless. (3%)

3. Assume that a general modulated carrier is given by

$$s(t) = A(t) \cos[\omega_c t + \phi(t)],$$

and the modulating signal $m(t)$ has a bandwidth of B .

- (a) Give the relationship between $m(t)$ and $A(t)$ for the double-side band large carrier modulation (AM). (4%)
- (b) Give the relationship between $m(t)$ and $\phi(t)$ for the frequency modulation (FM). (4%)
- (c) Give the relationship between $m(t)$ and $\phi(t)$ for the phase modulation (PM). (4%)
- (d) What is the bandwidth of $s(t)$ in part(a) ? (4%)
- (e) What is the bandwidth of $s(t)$ in part(b) ? (4%)

4. Prove that the minimum tone spacing for noncoherently detected orthogonal frequency shift keying signaling is $\frac{1}{T}$ where T is the symbol duration. (15%)

〈轉背圖〉

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5. Three possible messages m_1 , m_2 and m_3 are to be delivered over an additive white Gaussian noise (AWGN) channel. The messages are

$$s_1(t) = \begin{cases} 1 & 0 \leq t \leq T \\ 0 & \text{otherwise} \end{cases}$$

$$s_2(t) = -s_3(t) = \begin{cases} 1 & 0 \leq t \leq \frac{T}{2} \\ -1 & \frac{T}{2} \leq t \leq T \\ 0 & \text{otherwise} \end{cases}$$

- (a) What is the dimensionality of the signal space? (7%)
(b) Find an appropriate basis for the signal space. (8%)

6. A general representation of a set of M modulated signal waveforms is

$$u_m(t) = \sqrt{\frac{2E_s}{T}} g_T(t) \cos\left(2\pi f_c t + \frac{2\pi m}{M}\right), m = 0, 1, 2, \dots, M-1$$

- (a) Determine the corresponding complex envelope of $u_m(t)$. (10%)
(b) Select M to be 2 and define $g_T(t)$ as follows:

$$g_T(t) = \begin{cases} \frac{2At}{T} & 0 \leq t \leq \frac{T}{2} \\ 2A\left(1 - \frac{t}{T}\right) & \frac{T}{2} \leq t \leq T \\ 0 & \text{otherwise} \end{cases}$$

Under equal prior probabilities and AWGN channel with noise power-spectral density equal to $\frac{N_o}{2}$, what is the error probability? (10%)