

大同大學 九十四 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頁 共1頁

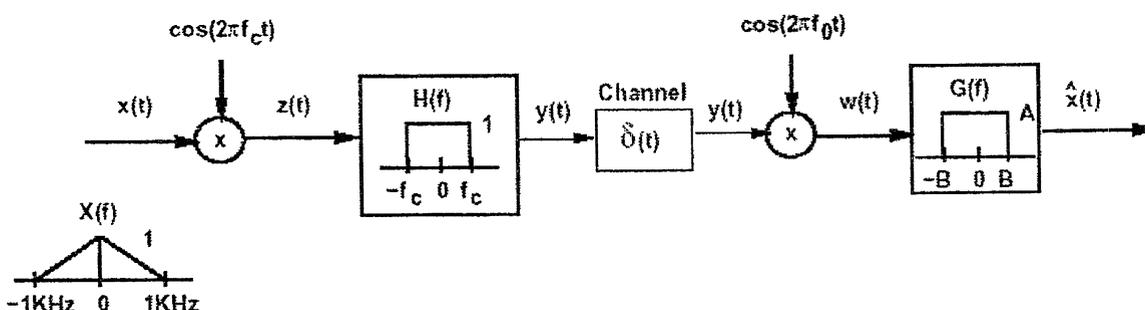
註：本次考試不可以參考自己的書籍及筆記； 不可以使用字典； 可以使用計算器。

※每題20分

1. Let $X(f) = \sum_{n=-2}^2 \delta(f - nf_0)$, for $f_0=10$ kHz.

- (a) Sketch $X(f)$.
- (b) Find $x(t)$, the inverse Fourier transform of $X(f)$.

2. Consider the communication system shown in figure below. The signal $x(t)$, with spectrum $X(f)$ as shown in the figure, is multiplied by a cosine of frequency $f_c=10$ kHz to obtain the signal $z(t)$. Then $z(t)$ is passed through a low-pass filter $H(f)$ with cutoff frequency f_c to produce the transmitted signal $y(t)$. The channel response is $\delta(t)$, thus the received signal is also $y(t)$, which in the receiver is multiplied by a cosine of frequency f_0 . The resulting signal $w(t)$ is passed through a low-pass filter $G(f)$ with cutoff frequency B and gain A . The signal at the output of the filter $G(f)$ is denoted by $\hat{x}(t)$.



- (a) Sketch $Z(f)$.
- (b) Sketch $Y(f)$.
- (c) Find the values of f_0 , A , and B such that $\hat{x}(t) = x(t)$.

3. Consider a composite wave obtained by adding a noncoherent carrier $A_c \cos(2\pi f_c t + \phi)$ to a DSBSC (double sideband suppressed carrier) wave $\cos(2\pi f_c t)m(t)$. This composite wave is applied to an ideal envelope detector. Find the resulting detector output. Evaluate this output for

- (a) $\phi=0$.
- (b) $\phi \neq 0$ and $|m(t)| \ll A_c/2$.

4. Consider a telephone modem that the usable channel bandwidth is 3429Hz and uses trellis-coded QAM modulation.

- (a) Calculate the bandwidth efficiency of such a modem, assuming the modem operates at 28.8 kbits/s.
- (b) Assuming AWGN and an available $E_b/N_0=10$ dB, calculate the theoretically available capacity in the 3429-Hz bandwidth.
- (c) What is the required E_b/N_0 that will enable a 3429-Hz bandwidth to have a capacity of 28.8 kbits/s?

5. What is the Nyquist filtering criterion expressed in:

- (a) the time domain; and
- (b) the frequency domain?