國立臺北科技大學九十九學年度碩士班招生考試

系所組別：2140 電機工程系碩士班丁組

第一節　通訊原理　試題

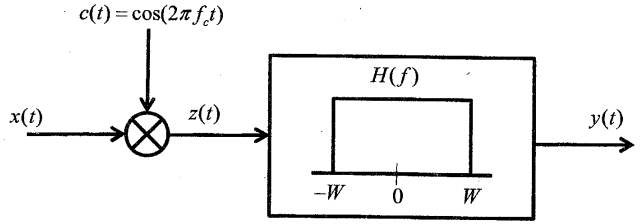
注意事項：

1.本試題共 5 題，配分共 100 分。

2.請標明大題、子題編號作答，不必抄題。

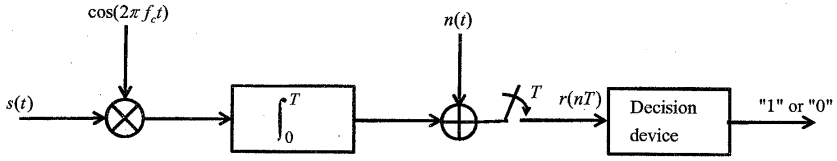
3.全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. (25%: (a) 5 points, (b) 10 points, (c) 10 points)
For the system shown below, the input $x(t) = 40\text{sinc}(20t)$ is modulated by the carrier $c(t) = \cos(2\pi 100t)$, and then sent through an ideal low pass filter $H(f)$ which passes all frequencies below $W = 100Hz$.

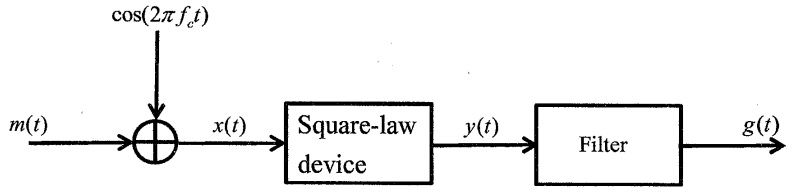


(a) Find $X(f)$, the Fourier transform of $x(t)$.
(b) Sketch $Z(f)$, the Fourier transform of $z(t) = x(t)\cos(2\pi 100t)$.
(c) Sketch $Y(f)$, the Fourier transform of the filter output.

2. (15%)
Assume a BPSK demodulation with an additional additive noise term at the input to its decision device, as shown in the figure below. The decision device outputs a "1" if the real part of its input $r(t)$ has $\text{Re}[r(t)] \geq 0$, and a "0" otherwise. Suppose the additive noise term $n(t) = 1.1e^{j\theta}$, where the probability $p(\theta = k\pi/3) = 1/6$ for $k = 0,1,2,3,4,5$. Assume corresponding to a "1" ($s(t) = \cos(2\pi f_c t)$) or a "0" ($s(t) = \cos(2\pi f_c t + \pi)$) are equally likely. Also assume $T = 1$ and $f_c >> 1$. What is the probability of making a decision error in the decision device, i.e., outputting the wrong demodulated bit ?



3. (20%: (a) 10 points, (b) 10 points)
Consider the system shown below. Assume the average value of $m(t)$ is zero and the maximum value of $|m(t)|$ is M. Suppose $m(t)$ is a narrowband signal within maximal frequency W. Assume the square-law device is defined by $y(t) = 4x(t) + 2x^2(t)$.



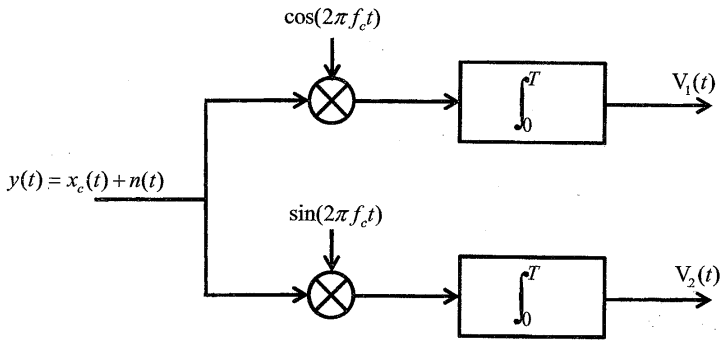
(a) Design the filter that yields an AM signal $g(t)$, i.e., specify the required minimal center frequency and the required minimal bandwidth of the filter.
(b) What value of M yields a modulation index of 0.1 ?

注意：背面尚有試題

4. (20%: (a) 10 points, (b) 10 points)
Consider the QPSK demodulator shown below. Assume the QPSK modulator produces a phase imbalanced signal of the form

$$x_c(t) = Ad_1(t)\cos(2\pi f_c t + \beta/2) - Ad_2(t)\sin(2\pi f_c t - \beta/2)$$

where $d_1(t)$ and $d_2(t)$ are "+1" or "-1" of duration T with equal probability and $\beta \neq 0$. Assume the system is synchronized in terms of time slots. Assume $n(t)$ is additive white Gaussian noise with double-sided power spectral density $N_0/2$.



(a) Find the integrator outputs, i.e., $V_1(t)$ and $V_2(t)$.
(b) Find the probability of error per quadrature channel.

5. (20%: (a) 10 points, (b) 10 points)
A parity-check code has the parity-check matrix

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 \end{bmatrix}$$

(a) Determine the generator matrix **G** and find all possible codewords.
(b) Determine the minimum distance of the code, and determine up to how many bit errors could the code successfully correct.