國立臺灣科技大學103學年度碩士班招生試題

系所組別： 電機工程系碩士班己一組

科　　目： 通訊系統

（總分為100分）

Problem 1: (25 %)

Assume the modulated signal is generated as

$$x(t)=\left(\cos\left(2\omega_0 t\right)+\sin^2\left(\omega_0 t\right)\right)\cos(\omega_c t)$$

with the carrier frequency related with the frequency of modulating signal by $\omega_c \gg 2\omega_0$.

(a) (5 %) Find and sketch the spectrum of the modulated signal $x(t)$. Label all the corresponding magnitudes if necessary.

(b) (5 %) What is the average power of the modulated signal $x(t)$?

(c) (7 %) What is the (time-domain) output of the Hilbert transform of the modulating signal $\cos\left(2\omega_0 t\right)+\sin^2\left(\omega_0 t\right)$?

(d) (8 %) Is it possible to, in the absence of noise, demodulate the transmitted signal $x(t)$ using a non-coherent demodulator? You have to give reason(s) to get full points.

Problem 2: (15 %)

Let $x(t)=\frac{\sin(2400\pi t)}{3600\pi t}$.

(a) (8 %) Determine the Nyquist rate of $x(t)$.

(b) (7 %) To ensure there is no intersymbol interference induced by the transmit waveform as which $x(t)$ is used, what are the allowable symbol rates?

Problem 3: (10 %)

Consider a modulator with the output expressed as:

$$x_c(t)=8\cos\left[2000\pi t+\phi(t)\right]=8\cos\left[2000\pi t+2\pi f_d\int_{-\infty}^{t} m(\tau)d\tau\right]$$

The modulator operates with frequency sensitivity $f_d=8$ and the input message signal $m(t)=5\cos(16\pi t)$.

(a) (5 %) Is this modulator linear? You have to give a proof to get full points.

(b) (5 %) Determine maximum frequency deviation.

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Problem 4: (20%)

Assume that you are designing a digital system with a uniform quantizer of the midrise type as Figure 1. Let the input be a 2W signal with continuous amplitude in the range (-4V, 4V), and the quantization noise be a uniformly distributed random variable in each step.

Give your answers for the following design parameters: **minimum resolution** of analog-to-digital converter required (**in terms of bits per sample**), the **probability density function (pdf)** and **variance** of the quantization error, and the output **signal-to-noise ratio (SNR)** of the uniform quantizer.

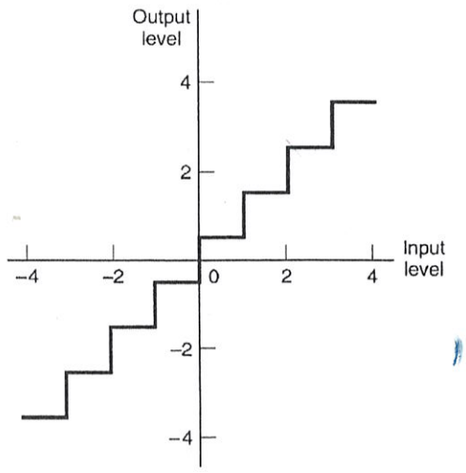

Figure 1. The uniform quantizer of the midrise type.