國立成功大學

114學年度碩士班招生考試試題

編　號：84

系　所：工程科學系

科　目：通信系統

日　期：0211

節　次：第 1 節

注　意：1.不可使用計算機
2.請於答案卷(卡)作答，於試題上作答，不予計分。

1) **Problem 1 (30%)**

(a) (5%) A generic point-to-point communication system can be characterized by three major functional blocks, including a transmitter, a channel, and a receiver. Please tell which block is the most important part of the system. Explain why?

(b) (5%) There are in general three fundamental performance metrics to measure the efficiency of an either analog or digital communication system. What are the three fundamental performance metrics?

(c) (5%) An envelope detector may be used to recover message signal at an AM receiver. Can it be used to detect DSB-SC signal at the receiver? Explain why?

(d) (5%) It is a well recognized fact that an FM radio can provide a far much better signal fidelity than an AM radio. Explain why?

(e) (5%) There are two angle modulation schemes, i.e., FM and PM. FM has been widely used in FM radio broadcasting services. Explain why PM has never been used in radio broadcasting services.

(f) (5%) Pre-emphasis and de-emphasis have to be used in FM broadcasting systems. What are the functions for the pre-emphasis and de-emphasis?

2) **Problem 2 (20%)**

Consider a square-law detector, and use a nonlinear device whose transfer characteristic is defined by

$$v_2(t) = a_1 v_1(t) + a_2 v_1^2(t),$$

where a_1 and a_2 are constants, $v_1(t)$ is the input, and $v_2(t)$ is the output. The input consists of the AM signal

$$v_1(t) = A_c\,[1 + k_a m(t)]\cos(2\pi f_c t),$$

where A_c is the carrier amplitude, k_a is the modulation index, $m(t)$ is the message signal, and f_c is the carrier frequency.

(a) (5%) Evaluate the output $v_2(t)$ from the square-law detector.

(b) (5%) If an ideal low pass filter (LPF) is added after the square-law detector, what is the output signal $y(t)$ from the LPF?

(c) (10%) Find the conditions for which the message signal $m(t)$ can be recovered from $v_2(t)$.

3) **Problem 3 (30%)**

Consider a message signal $m(t)$ with the spectrum shown in Fig. 1. The message signal bandwidth is $W = 1$ kHz, which is applied to a product modulator with a carrier signal $A_c \cos(2\pi f_c t)$ as another input, producing DSB-SC modulated signal $s(t)$. At the receiver, the modulated signal is applied to a coherent detector. Assume perfect synchronism between the carrier signals in the modulator and detector. Plot the spectrum of the detector output signal when

(a) (10%) the carrier frequency is $f_c = 1.25$ kHz;

(b) (10%) the carrier frequency is $f_c = 0.75$ kHz.

(b) (10%) What is the lowest carrier frequency, at which each component of the message signal $m(t)$ can be recovered at a receiver without distortion?

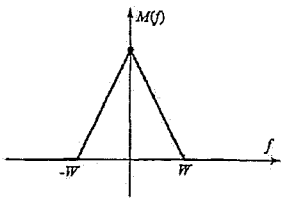

Fig. 1

4) **Problem 4 (20%)**

An FM modulated signal is

$$u(t) = 100 \cos\left[2\pi f_c t + 100 \int_{-\infty}^{t} m(\tau) d\tau\right],$$

where $m(t)$ is the message signal as shown in Fig. 2.

(a) (5%) Draw the instantaneous frequency as a function of time.

(b) (5%) What is the maximum frequency deviation of the FM signal (Δf_{max})?

(c) (5%) What is the modulation index of the FM signal (β_f)? (Hint: The bandwidth of a periodic bipolar square waveform can be approximated by the reciprocal of its period.)

(d) (5%) What is the bandwidth of FM signal?

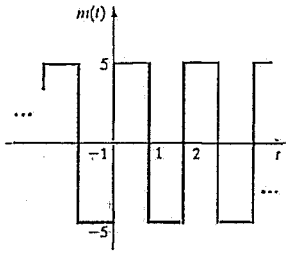

Fig. 2