國立成功大學

115學年度碩士班招生考試試題

編　號：77

系　所：工程科學系

科　目：通信系統

日　期：0204

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%) What is the name of the 4th generation mobile communication systems?

(b) (5%) What type of multiple access technology is used in the 4th generation mobile communications?

(c) (5%) Frequency modulation (FM) radio broadcasting systems have been widely used. Explain why phase modulation (PM) has never been used in broadcasting systems?

(d) (5%) Explain why we have to use low earth orbit (LEO) satellites for global satellite mobile communications?

(e) (5%) There are four widely used AM schemes. What are they? Which one is the most bandwidth efficient scheme?

(f) (5%) If the bandwidth of message signal is W, how many times larger the bandwidth of FM signal is compared to the conventional AM signal (assume that the FM index is β)?

2) **Problem 2 (10%)**

Determine the Fourier-series expansion of the periodic signal $x(t)$ shown in Fig. 1.

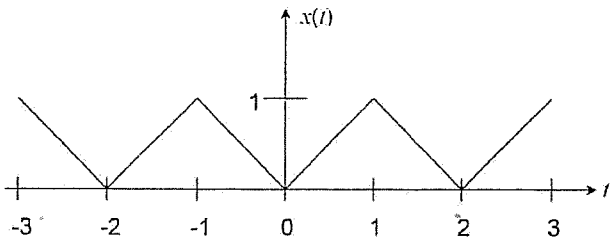

Fig. 1

3) **Problem 3 (10%)**

The Hilbert transform of $x(t)$ is defined as

$$\hat{x}(t) = \frac{1}{\pi}\int_{-\infty}^{\infty}\frac{x(\tau)}{t-\tau}\,d\tau.$$

Prove the following properties:

(a) (5%) If $x(t) = x(-t)$, then $\hat{x}(t) = -\hat{x}(-t)$.

(b) (5%) If $x(t) = \cos(\omega_0 t)$, then $\hat{x}(t) = \sin(\omega_0 t)$.

4) **Problem 4 (10%)**

Find the continuous time Fourier transform of the following signals:

a) (5%) $x(t) = [\frac{\sin(5\pi t)}{\pi t}][\frac{\sin(7\pi t)}{5\pi t}]$.

b) (5%) $x(t) = e^{-t+3}u(t-3)$, where $u(t)$ is a unit step function.

5) **Problem 5 (15%)**

The output signal from an AM modulator is

$$u(t) = 5\cos(280\pi t) + 25\cos(300\pi t) + 5\cos(320\pi t).$$

a) (5%) Determine the modulating signal $m(t)$ and the carrier signal $c(t)$.

b) (5%) Determine the modulation index.

c) (5%) Determine the ratio of the power in the sidebands to the power in the carrier.

6) **Problem 6 (25%)**

An angle-modulated signal has the form

$$u(t) = 200\cos(2\pi f_c t + 3\sin(500\pi t)),$$

where $f_c = 10$ MHz.

a) (5%) Determine the average transmitted power.

b) (5%) Determine the peak-phase deviation.

c) (5%) Determine the peak-frequency deviation.

d) (5%) Using Carson's rule, find the bandwidth of the modulated signal.

e) (5%) If message signal is $m(t) = \sin(500\pi t)$, is $u(t)$ an FM signal or a PM signal?