（總分為100分）

總分 100 分

Problem 1 (20%)

Let an AM signal be $m(t) = \left(1 + \frac{1}{2}\sin(2\pi f_m t)\right)\cos(2\pi f_c t)$, where $f_m = 80 KHz, f_c = 500 MHz$.

(a). (10 %) Determine the modulation index μ.

(b). (10 %) Determine the power efficiency η.

Problem 2 (15%)

The Hilbert transform function is defined as

$$H(f) = \begin{cases} -j, & f > 0 \\ j, & f < 0 \end{cases}$$

Let an input signal of a Hilbert transform filter be $x(t) = \cos(2\pi f_0 t)$. Find the filter output signal $x_h(t)$.

Problem 3 (15%)

Prove Parseval's theorem for Fourier Transforms

$$Energy\ of\ a\ signal = \int_{-\infty}^{\infty} |x(t)|^2\, dt = \int_{-\infty}^{\infty} |X(f)|^2\, df.$$

Problem 4 (20%)

Assume an analog signal $x(t)$ has a bandwidth occupation from $4KHz$ to $30KHz$. One may deliver $x(t)$ using digital transmission.

(a). (10 %) At least how frequent the signal $x(t)$ has to be sampled such that the aliasing can be avoided at receiver? Write it in terms of frequency.

(b). (10 %) Assume the frequency response of $x(t)$, i.e. $X(f)$, is as shown in Fig. **P4**. Plot the frequency response of the sampled output $x[n] = x(nT_s)$ when the sampling frequency is set at $28KHz$, namely $T_s = 1/28,000$ sec.
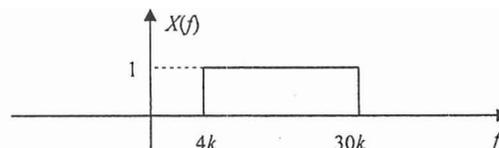

Fig. **P4**

國立台灣科技大學九十九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 5 (20%)

Assume binary data of 9,600 bits/sec are transmitted using 8-ary PAM pulses. Further, a pulse shaping filter of *sinc* function is adopted, where $\text{sinc}(y) = \frac{\sin \pi y}{\pi y}$.

(a). (10 %) What is the symbol rate?

(b). (10 %) What is the minimum system bandwidth required for the detection of 8-ary PAM with no inter-symbol interference (ISI)?

Problem 6 (10%)

Assume we employ orthogonal binary frequency-shift keying (FSK) modulation. Indeed, for binary '0' $s_1(t) = 0.5\cos(2000000\pi t)$ is transmitted while $s_2(t) = 0.5\cos(2000020\pi t)$ is conveyed for binary '1'. A phase offset θ due to time delay between transmitter and receiver is assumed. Further, the coherent detection is implemented at receiver. What is the maximum transmission speed, in terms of symbol rate, for this digital communication system?