

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1) (20 marks, 5 marks each) With the help of the four given signal waveforms as shown in Fig. 1, plot the following signal waveforms:

- a)  $x_1(t) = \Pi(2t + 5)$ .
- b)  $x_2(t) = \sum_{n=0}^{\infty} \Lambda(t - n)$ .
- c)  $x_3(t) = \text{sgn}(2t) - \text{sgn}(t)$ .
- d)  $x_4(t) = \text{sinc}(10t)$ .

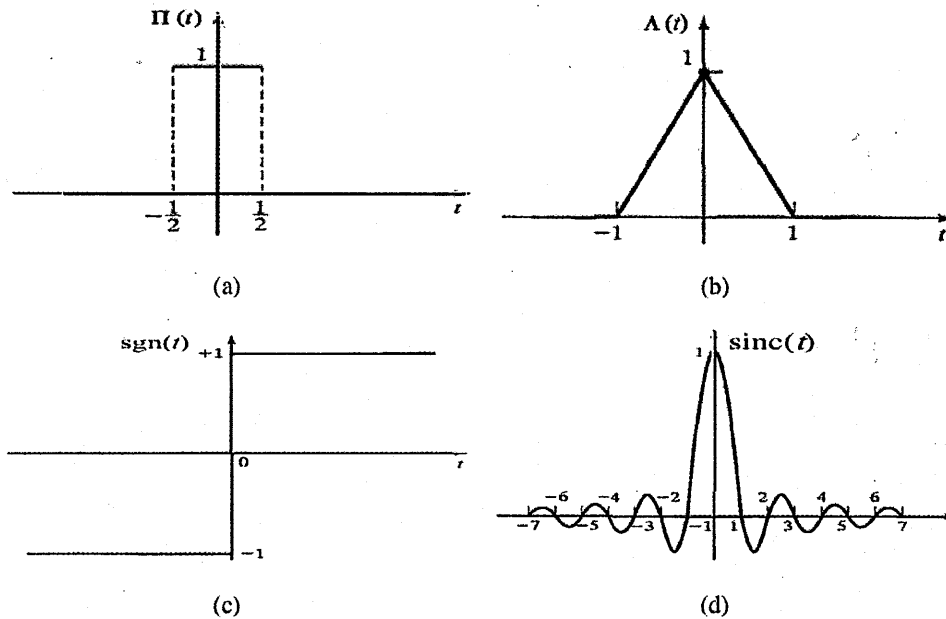


Fig. 1. The four given signal waveforms:  $\Pi(t)$ ,  $\Lambda(t)$ ,  $\text{sgn}(t)$ , and  $\text{sinc}(t)$ .

2) (20 marks, 5 marks each) The message signal  $m(t) = 2 \cos 400t + 4 \sin(500t + \pi/3)$  modulates the carrier signal  $c(t) = A \cos(8000\pi t)$ , using DSB amplitude modulation.

- a) Find the time-domain representations of the modulated signal.
- b) Find the frequency-domain representations of the modulated signal.
- c) Plot the spectrum (i.e., the Fourier transform) of the modulated signal.
- d) What is the power content of the modulated signal?

3) (30 marks, 5 marks each) The message signal  $m(t)$ , whose spectrum is shown in Fig. 2, is passed through the system shown in that figure. The bandpass filter has a bandwidth of  $2W$  centered at  $f_0$ , and the lowpass filter has a bandwidth of  $W$ .

- Plot the spectrum of the signal  $x(t)$ .
- Plot the spectrum of the signal  $y_1(t)$ .
- Plot the spectrum of the signal  $y_2(t)$ .
- Plot the spectrum of the signal  $y_3(t)$ .
- Plot the spectrum of the signal  $y_4(t)$ .
- What are the bandwidths of the signals?

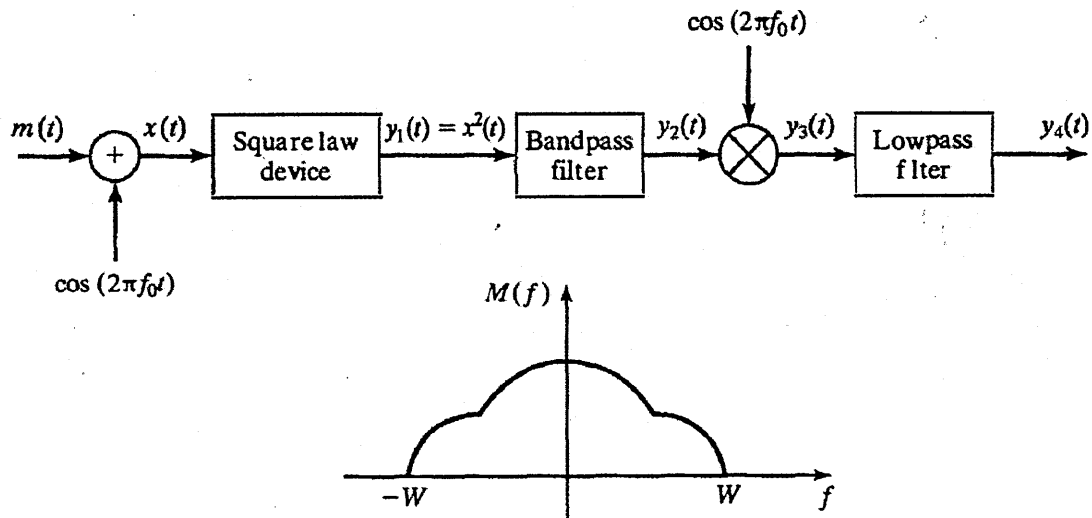


Fig. 2. Problem 3.

- 4) (30 marks) The message signal  $m(t) = 10 \text{ sinc}(400t)$  frequency modulates the carrier  $c(t) = 100 \cos 2\pi f_c t$ . The modulation index  $\beta_f$  is 6, where we have  $\beta_f = \frac{k_f \max\{|m(t)|\}}{W}$ .
- (7 marks) Write an expression for the modulated signal  $u(t)$ .
  - (7 marks) What is the maximum frequency deviation of the modulated signal?
  - (7 marks) What is the power content of the modulated signal?
  - (9 marks) Find the bandwidth of the modulated signal.