7.2-2

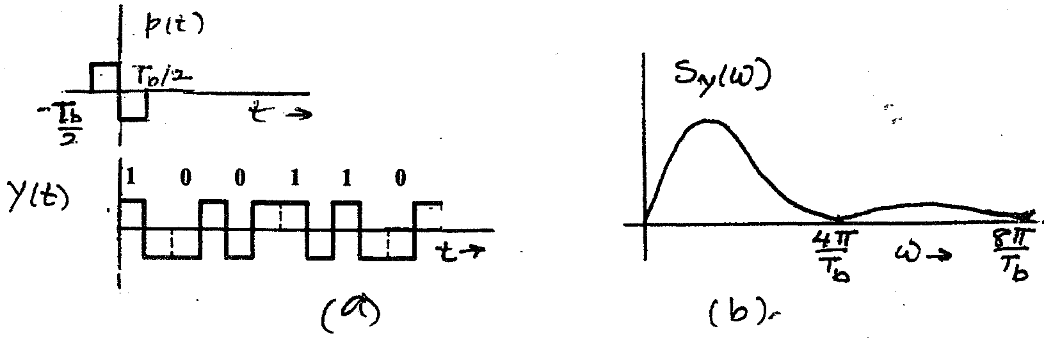

Fig. S7.2-2

$$P(t) = \text{rect}\left(\frac{t+\frac{T_b}{4}}{\frac{T_b}{2}}\right) - \text{rect}\left(\frac{t-\frac{T_b}{4}}{\frac{T_b}{2}}\right)$$

and

$$P(\omega) = \frac{T_b}{2}\text{sinc}\left(\frac{\omega T_b}{4}\right)e^{j\omega T_b/4} + \frac{T_b}{2}\text{sinc}\left(\frac{\omega T_b}{4}\right)e^{-j\omega T_b/4}$$

$$= jT_b\,\text{sinc}\left(\frac{\omega T_b}{4}\right)\,\sin\left(\frac{\omega T_b}{4}\right)$$

$$S_y(\omega) = \frac{|P(\omega)|^2}{T_b} = T_b\,\text{sinc}^2\left(\frac{\omega T_b}{4}\right)\,\sin^2\left(\frac{\omega T_b}{4}\right)$$

From Fig. S7.2-2, it is clear that the bandwidth is $\frac{4\pi}{T_b}$ rad / s or $2R_b$ Hz.

7.2-3 For differential code (Fig. 7.17)

$$R_0 = \lim_{N\to\infty} \frac{1}{N}\left[\frac{N}{2}(1)^2 + \frac{N}{2}(-1)^2\right] = 1$$

To compute R_1, we observe that there are four possible 2-bit sequences **11**, **00**, **01**, and **10**, which are equally likely. The product $a_k a_{k+1}$ for the first two combinations is 1 and is -1 for the last two combinations. Hence,

$$R_1 = \lim_{N\to\infty} \frac{1}{N}\left[\frac{N}{2}(1) + \frac{N}{2}(-1)\right] = 0$$

Similarly, we can show that $R_n = 0 \qquad n > 1$ Hence,

$$S_y(\omega) = \frac{|P(\omega)|^2}{T_b} = \left(\frac{T_b}{4}\right)\text{sinc}^2\left(\frac{\omega T_b}{4}\right)$$