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6.26.

For coherent case:

$$P_e = \frac{1}{2}\,\mathrm{erfc}\left(\sqrt{\frac{E_b}{N_0}}\right) = 10^{-5}$$

$$\Rightarrow \sqrt{\frac{E_b}{N_0}} \simeq 3.015$$

$$\Rightarrow \frac{E_b}{N_0} \simeq 9.225 \simeq 9.6\ (dB)$$

For noncoherent case:

$$P_e = \frac{1}{2} e^{-\frac{E_b}{2N_0}} = 10^{-5}$$

$$\Rightarrow \frac{E_b}{2N_0} = 10.819$$

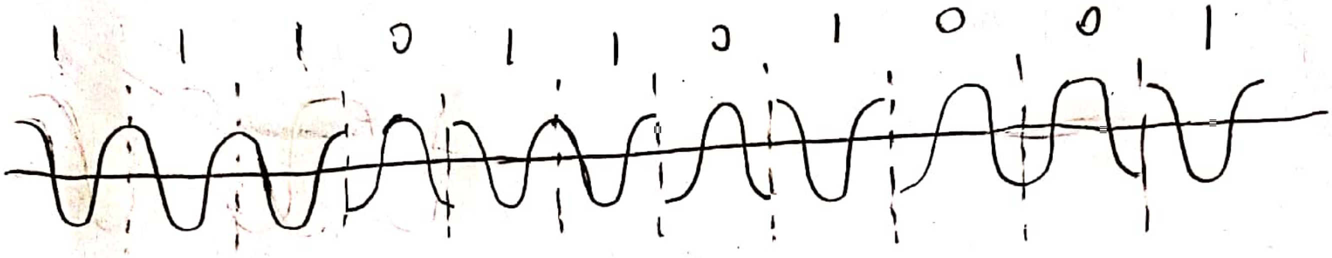
$$\Rightarrow \frac{E_b}{2N_0} = 21.638 \simeq 13.3\ (dB)$$

It increases 3.7 (dB)

6.33

Input b_k		1	1	0	0	1	0	0	0	1	0
Delayed d_{k-1}		1	1	1	0	1	1	0	1	0	0
encoded sequence d_k	1	1	1	0	1	1	0	1	0	0	1
phase	0	0	0	π	0	0	π	0	π	π	0

(a)



(b) Assume $s(t) = \begin{cases} A\cos(2\pi f_c t + \theta) & \text{if } d_k = 1 \\ A\cos(2\pi f_c t + \theta + \pi) & \text{if } d_k = 0 \end{cases}$ where θ is the unknown phase.

$$\Rightarrow s(t) = \begin{cases} A\cos\theta\cos(2\pi f_c t) - A\sin\theta\sin(2\pi f_c t) & \text{if } d_k = 1 \\ -A\cos\theta\cos(2\pi f_c t) + A\sin\theta\sin(2\pi f_c t) & \text{if } d_k = 0 \end{cases}$$

Since we disgard the affect of noise, it's not hard to see y (in Figure 6.43) is given by

$$y = \begin{cases} A^2 & \text{if } d_k = d_{k-1} \\ -A^2 & \text{if } d_k \neq d_{k-1} \end{cases}$$

Thus, we can reconstruct the original binary sequence

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