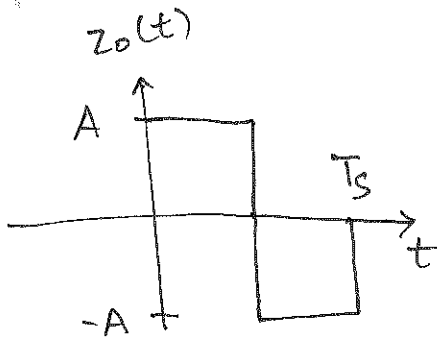
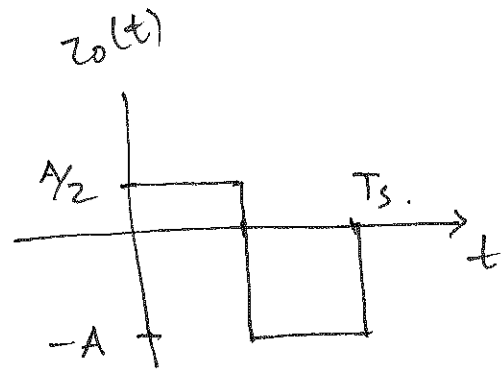


6.1



Constellation I



constellation II

Sol

For constellation I

$$E_0 = A^2 T_s$$

$$E_1 = A^2 \frac{T_s}{2} + \frac{A^2}{4} \frac{T_s}{2} = \frac{A^2 T_s}{2} \left(\frac{5}{4} \right) = \frac{5 A^2 T_s}{8}$$

$$E_b^{(I)} = \left(\frac{5 A^2 T_s}{8} + A^2 T_s \right) \frac{1}{2} = \frac{13}{16} A^2 T_s$$

$$D_{01}^{2(I)} = \frac{9 A^2}{4} \frac{T_s}{2}$$

$$d_{01}^{2(I)} = \frac{D_{01}^{2(I)}}{2 E_b^{(I)}} = \frac{9}{13}$$

For constellation II

$$E_0 = \frac{5A^2 T_s}{8}$$

$$\Rightarrow E_b = \frac{1}{2} \left(2 \cdot \frac{5A^2 T_s}{8} \right) = \frac{5A^2 T_s}{8}$$

$$E_1 = \frac{5}{8} A^2 T_s$$

$$D_{01}^2 = \frac{T_s}{4} \left(\frac{A^2}{4} + A^2 + \frac{9}{4} A^2 + 0 \right) = \frac{T_s}{4} \cdot \frac{14}{4} A^2 = \frac{14}{16} A^2 T_s$$

$$d_{01}^{2\text{II}} = \frac{7}{10}$$

$$\text{Energy efficiency} = 10 \log_{10} \left(\frac{d_{01}^{2\text{(I)}}}{d_{01}^{2\text{(II)}}} \right)$$

$$= 10 \log_{10} \left(\frac{9/13}{7/10} \right) = -0.04 \text{ dB}$$

Hence constellation II is better than constellation I
by 0.04 dB