Q1: Proakis - Communication Systems Engineering (2nd Ed) 7.43
Q2: Proakis - Communication Systems Engineering (2nd Ed) 7.44
Q3: Proakis - Communication Systems Engineering (2nd Ed) 7.46
Q4: Proakis - Digital Communications (5th Ed) 4.23

M-ary transmission & QAM

Q1. Consider the two 8-point QAM signal constellation shown in Figure P-7.43. The minimum distance between adjacent points is $2A$. Determine the average transmitted power for each constellation assuming that the signal points are equally probable. Which constellation is more power efficient?

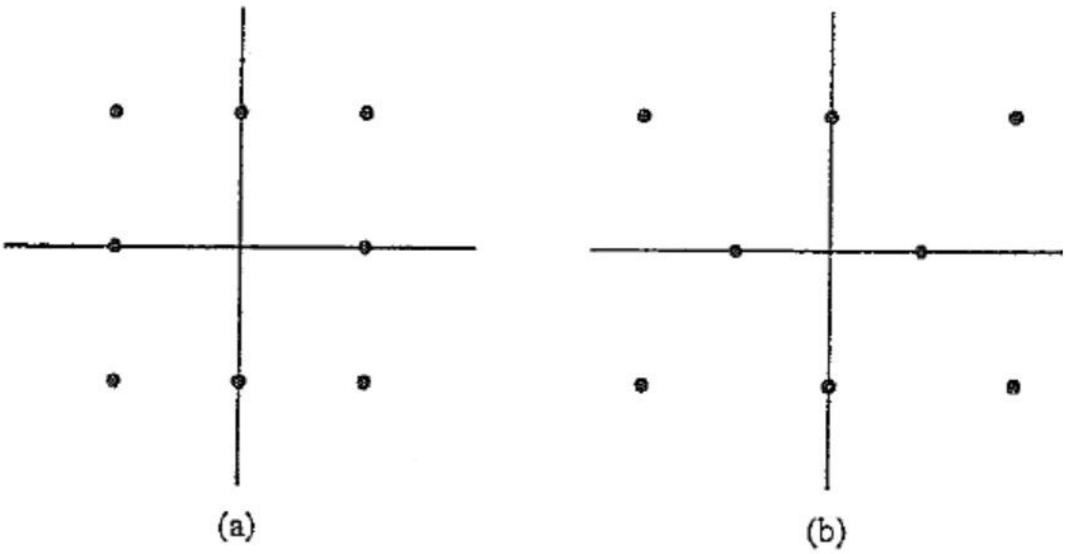


Figure P-7.43

$$P_{avg_a} = \frac{1}{8}\left[4\cdot(2A)^2 + 4\cdot(2\sqrt{2}A)^2\right]$$

$$P_{avg_b} = \frac{1}{8}\left[2A^2 + 2(\sqrt{3}A)^2 + 4\cdot(\sqrt{7}A)^2\right]$$

b is more power efficient

Q2. The 16-QAM signal constellation shown in Figure P-7.44 is an international standard for telephone-line modems (called V.29). Determine the optimum decision boundaries for the detector, assuming that the SNR is sufficiently high so that errors only occur between adjacent points.

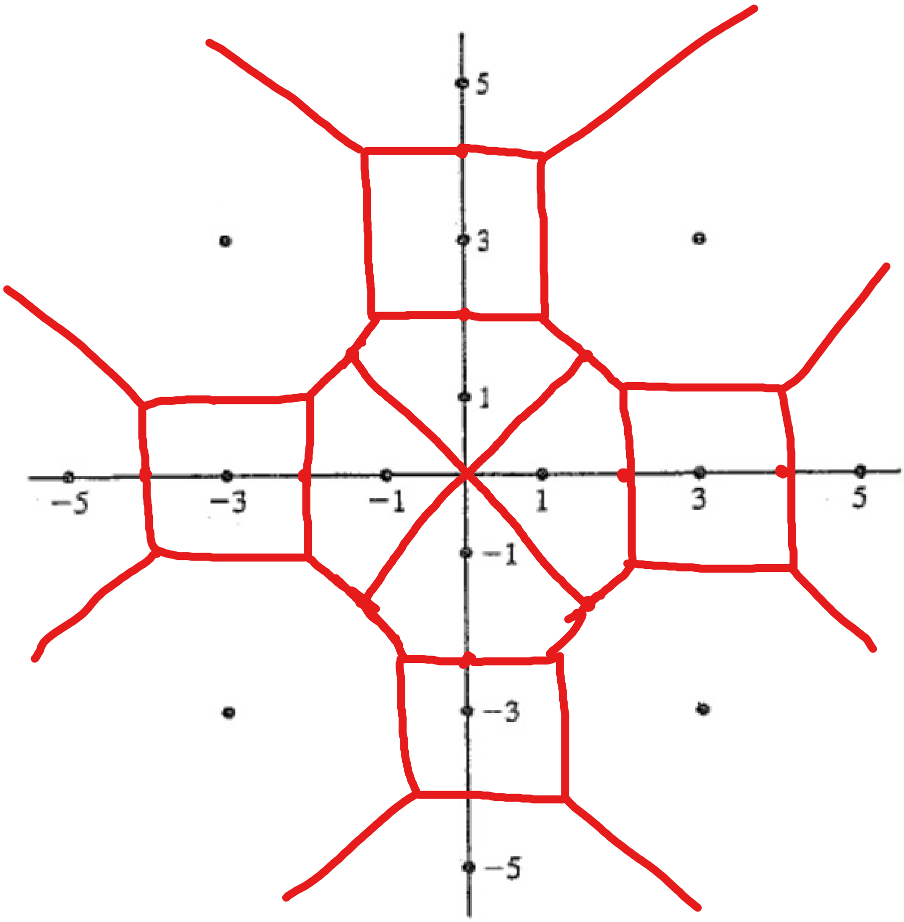


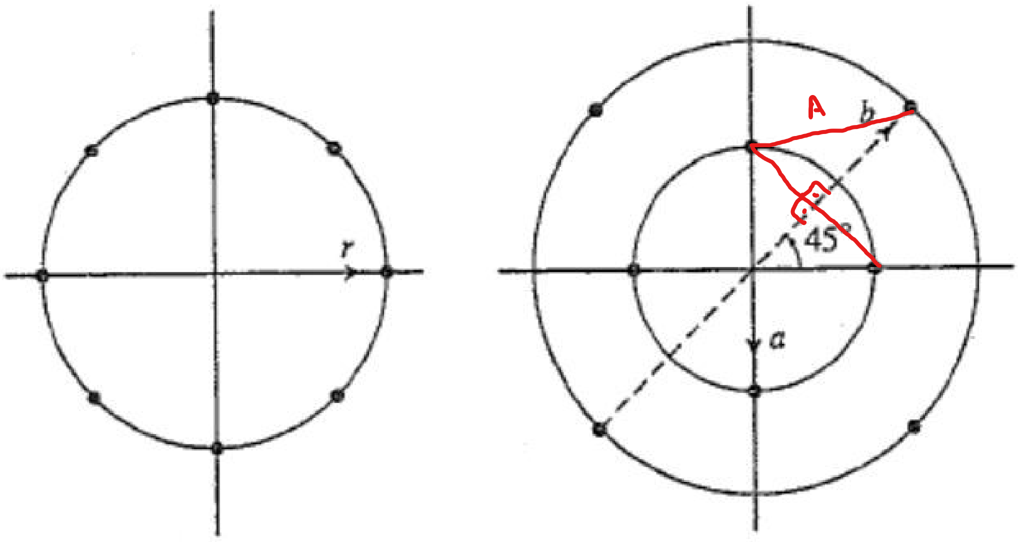
Figure P-7.44

Q3. Consider the octal signal-point constellations in Figure P-7.46.

a. The nearest neighbor signal points in the 8-QAM signal constellation are separated in distance by A units. Determine the radii a and b of the inner and outer circles.

b. The adjacent signal points in the 8-PSK are separated by a distance of A units. Determine the radius r of the circle.

c. Determine the average transmitter powers for the two signal constellations and compare the two powers. What is the relative power advantage of one constellation over the other? (Assume that all signal points are equally probable).



8–PSK 8–QAM

Figure P-7.46

a.) önce A-a iliskisi, sonra b yi bulmak icin iki tane dik ücgen
b.) cosine theorem

c.) $P_{avg} = \frac{1}{8}[8r^2]$ (8-PSK)

$P_{avg} = \frac{1}{8}[4a^2 + 4b^2]$ (8-QAM)

$\frac{P_{PSK}}{P_{QAM}} = \ldots$

Q4. Consider a digital communication system that transmits information via QAM over a voice-band telephone channel at a rate of 2400 symbols/s. The additive noise is assumed to be white and Gaussian.

a. Determine the E_b/N_0 required to achieve an error probability of 10^{-5} at 4800 bits/s.

b. Repeat part 1 for a rate of 9600 bits/s.

c. Repeat part 1 for a rate of 19200 bits/s.

d. What conclusions do you reach from these results?

a.) $k = \frac{4800}{2400} = 2 \Rightarrow$ 4-QAM

$$P_m = 1 - \left(1 - 2\left(1 - \frac{1}{\sqrt{m}}\right) Q\left[\sqrt{\frac{3k\,E_b}{(m-1)N_0}}\right]\right)^2$$

q functiondaki deere göre Eb/No deerini bul desibele çevir

dB conversion

$10 \log_{10}(\dots)$