Wireless Communications Technologies

Course No: 16:332:559 - (Spring 2002)

Homework 3

1. Derive the psd of M-ary PSK.

2. Sketch BER vs. SNR plots for M-ary FSK for the cases of \( K = 1, 2, 3, 4, 5 \) where \( K = \log_2 M \).

3. An \( M \)-QAM system can thought of as two PAM systems in quadrature, each having \( \sqrt{M} = 2^m \) constellation points and one-half the power of the QAM system. Show that the probability of error for such a \( \sqrt{M} \)-PAM system is

\[
P_{\sqrt{M}} = 2(1 - \frac{1}{\sqrt{M}})Q(\sqrt{\frac{6}{M-1} \gamma_s}),
\]

where \( \gamma_s \) is the average received symbol energy-to-noise ratio for the \( M \)-QAM signal constellation.

4. The squared euclidean distance between a pair of CPM bandpass waveforms \( s(t; x^{(i)}) \) and \( s(t; x^{(j)}) \) is given as

\[
D^2 = \int_0^\infty [s(t; x^{(i)}) - s(t; x^{(j)})]^2 dt
\]

Show that

\[
D^2 = 2 \log_2 M E_b \frac{1}{T} \int_0^\infty (1 - \cos(\Delta \phi(t))) dt
\]

where \( M \) is the symbol alphabet size, \( E_b \) is the energy per bit and \( \Delta \phi(t) \) is the phase difference between the two signals.

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