

TCOM 500: Modern Telecommunications
Prof. B.-P. Paris
Homework 9
Solution

Solutions

1. Error Probability

- (a) When E_b/N_0 equals 10dB, then $P_e = Q(\sqrt{20}) = 3.8 \cdot 10^{-6}$.
- (b) Need to find E_b/N_0 such that $Q(\sqrt{2E_b/N_0}) = 10^{-5}$. This is accomplished for $E_b/N_0 = 9.1 = 9.6$ dB.

2. Phase Error

- (a) For the given values, $2 \cos(\pi/6)E_b/N_0 = 10.9$. Therefore,
 $P_e = Q(\sqrt{2 \cos(\pi/6)E_b/N_0}) = 4.8 \cdot 10^{-4}$.
- (b) Without phase error, E_b/N_0 can be reduced by $-10 \log_{10}(\cos(\pi/6)) = 0.6$ dB.
- (c) For $\phi = \pi/3$, error rate is $P_e = 6 \cdot 10^{-3}$ and one could save 3 dB without phase error.
For $\phi = \pi/2$, error rate is $P_e = \frac{1}{2}$. It is not possible to reduce this error rate by increasing E_b/N_0 , because $\cos(\pi/2) = 0$.