

BINARY BANDPASS MODULATION PROBLEM SHEET

(extracted from *Digital Communications* by Andy Bateman- Addison Wesley pp138-139)

1. A coherent binary ASK data system has a phase error of 25° in the recovered carrier reference. What will be the percentage reduction in symbol output voltage from the mixer detector and how much must the input symbol energy be increased to compensate for the loss due to carrier error?
2. A binary ASK modem used non-coherent detection. With reference to the BER curves for binary ASK in the notes, what is the E_b/N_0 value required to achieve an error probability of less than 1 in 10^2 ? What is the equivalent performance of a coherent ASK scheme at this E_b/N_0 value.
3. A coherent binary ASK modem is found to have a phase error in the recovered carrier of 45° . Will the performance of this modem be improved if non-coherent detection is used instead of the imperfect coherent detection process?
4. Draw the constellation diagram for a four-level ASK modulation format using a $\sin \omega_c t$ carrier when the modulation input is:

A four level unipolar signal

A four level bipolar signal.
5. What is the bit error probability for non-coherent binary FSK for an E_b/N_0 value of 10 dB? What approximate E_b/N_0 is required to achieve the same BER performance for coherent FSK and coherent ASK?
6. A designer has been asked to build a radio data modem that must be tolerant to a frequency error in the receiver system. He is less concerned about the noise tolerance of the modem. Which modulation format, ASK or FSK, would you recommend for this task?
7. A binary PSK modem is designed to work within a bandwidth of 8 kHz. What is the maximum data rate that can be delivered if a raised cosine filter with $\alpha = 1$ is used?
8. What is the bandwidth efficiency of a BPSK modem with a pulse-shaping filter with $\alpha = 0.5$?
9. When cables are installed in a building, it is not unusual for the engineers to get the connections of the twisted pair reversed. How can a binary signalling scheme be designed to cope with this eventuality and maintain correct polarity data transfer?
10. A DPSK transmitter can generate an average power of 1 nW at the input to a receiver which has a noise power density of 0.5×10^{-12} Watts/Hz. If the symbol rate is 100 symbols per second, what is the BER performance for a DPSK decoder in the receiver?