Concordia University
Department of Electrical and Computer Engineering
ELEC462: Digital Transmission Systems
Final Exam
Dec. 7, 2000

1) A hi-fi music signal has a bandwidth of 20 kHz. and the ratio of its peak to average power is 4.
a) Calculate the bit rate required to transmit this signal as a uniformly quantized PCM stream maintaining a SQNR of 70 dB. (5 Marks).
b) Find the minimum bandwidth required to transmit this data stream using 8-PSK modulation. (5 Marks)
2) In a communication system data is being transmitted over an AWGN channel using QPSK modulation.
(a) What is the minimum required $\frac{E_b}{N_0}$ so that the bit error probability does not exceed 10^{-5}? express your result in decibels (4 Marks)

(b) if the signal amplitude is 60 mV and the power spectral density of the noise is $\frac{N_0}{2} = 10^{-10}$, find the maximum bit rate such that the bit error probability does not exceed the specified value of 10^{-5} (7 Marks).
3) In the 16 QAM constellation of Figure 1, the minimum distance between the signals is 2.
a) Find the average signal energy (5 Marks),
b) Find the bit error probability as a function of N_0 (only N_0) . (6 Marks)
Note: If you cannot do part (a) make any assumption you need in part (b).
4) Data is being transmitted using 16-PSK modulation with raised cosine pulse shaping filter. If the bit rate is 2 Mbps and the available bandwidth is 400 kHz. find the maximum allowable roll-off factor (5 Marks).

5) The binary data stream 110101 is applied to a precoder and then to a duoduobinary coder. Construct the output of the precoder, the modified duobinary coder and the receiver output (5 Marks).
6) For $m = 5$ determine the Reed-Solomon code that can correct 3 erroneous symbols, i.e., find the block length N and the number of information symbols K (3 Marks). Find the rate of the code (2 Marks). What is the block length in bits (1 Mark).
7) Consider the convolutional code with the encoder shown in Figure 2.
a) What is the constraint length of this code? (1 Marks).
b) What are the generator polynomials of this code? (3 Marks)
c) Assume that the encoder is in state 0 (all flip-flops contain 0), find the output for the input ....00001101 (4 Marks) Note: Bit 1 enters the encoder first.

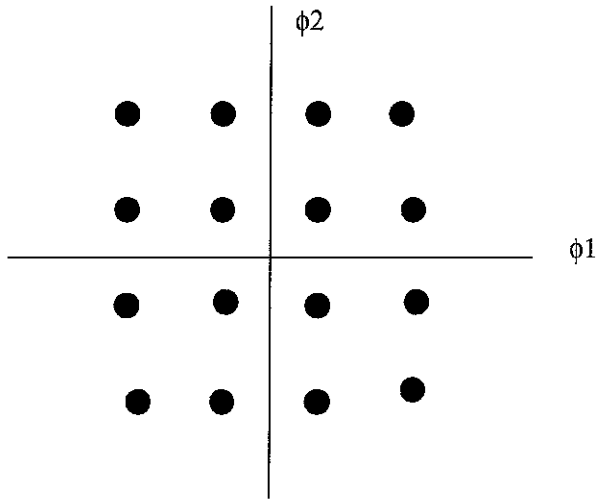

Figure 2: 16 QAM Signal Constellation

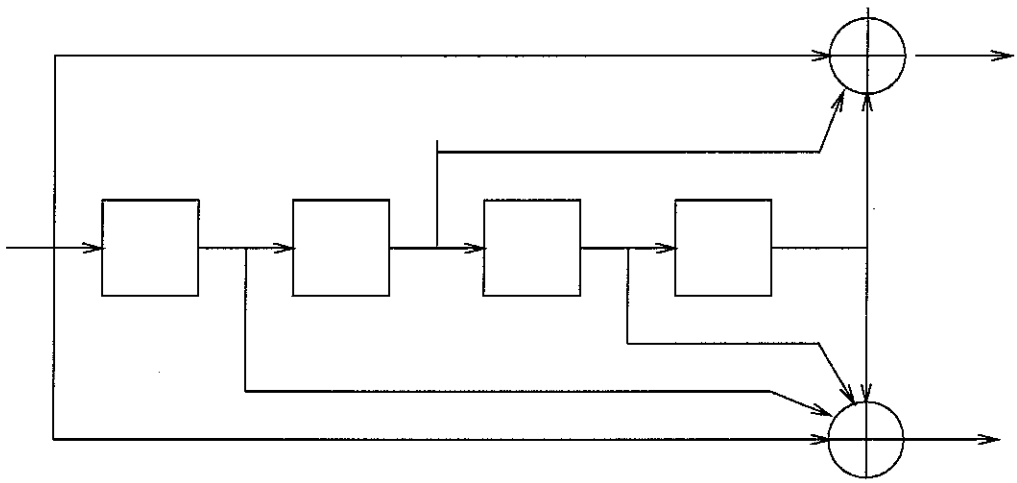

Figure 3: The encoder for convolutional code of problem 7

8) The generator polynomial of the (15,11) Hamming code is $g(X) = X^4 + X + 1$. Draw the block diagram of the encoder for this code in the systematic form (4 Marks).