Data Provided: None

The University Of Sheffield.

DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

Spring Semester 2013-2014 (2 hours)

Principles of Communications

Answer **THREE** questions. **No marks will be awarded for solutions to a fourth question.** Solutions will be considered in the order that they are presented in the answer book. Trial answers will be ignored if they are clearly crossed out. **The numbers given after each section of a question indicate the relative weighting of that section.**

1. a. Briefly describe the difference between binary and M-ary signalling systems. **(2)**

b. Explain briefly how the demodulation process in an AM DSB SC system improves the signal to noise ratio by a factor of two. **(4)**

c. A computer executes four instructions that are designated by the code words (00, 01, 10, 11). Assuming that the instructions are used independently with probabilities (0.5, 0.2, 0.15, 0.15), calculate the percentage by which the number of bits used for the instructions may be reduced by using Huffman coding. **(6)**

d. Derive an expression for the signal power at the output of the demodulator in FM systems. **(8)**

2. a. Explain what is meant by lossy and lossless data compression in digital communications. **(4)**

b. Determine the probability of obtaining a 1, 2 and 3 bit errors in a 5 bit code word when $P_E = 1\times10^{-9}$. **(4)**

c. Consider the convolutional encoder shown in Figure 1

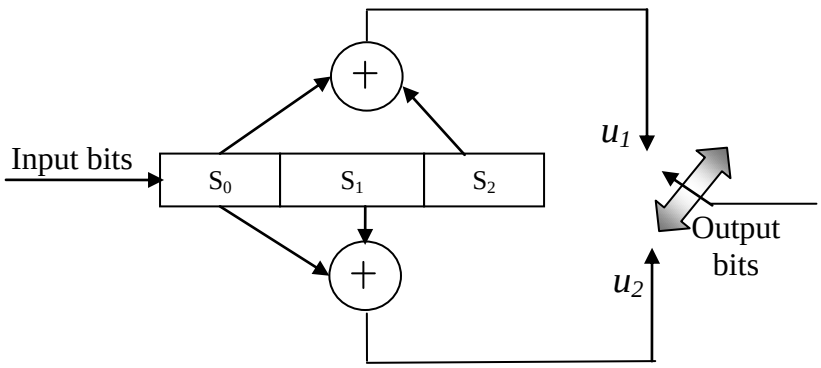

Figure 1

i. Assume the shift register is initialised with 000. Find the output sequence for an input bits sequence of 10010101.

ii. Draw the state diagram of this encoder. **(6)**

d. Explain the difference between hard and soft decisions in communication systems. **(6)**

3. a. Draw the impulse response of a matched filter which corresponds to the signals shown in Figures 2 and 3

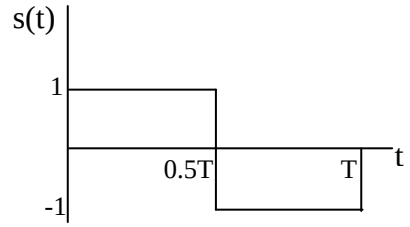

Figure 2

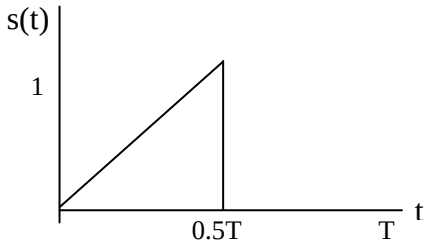

Figure 3 **(4)**

b. Explain briefly how the output signal of a matched filter is different from that of an analogue communication system's filter. **(4)**

c. Using diagrams as necessary, explain how a 16-Ary QAM signal can be generated. **(5)**

d. Explain with the aid of diagrams what is meant by Quaternary Phase Shift Keying (QPSK) and how QPSK signals can be generated and detected. **(7)**

4. a. Explain what is meant by a pseudo-noise **(**PN) code and state the properties of a good PN sequence. **(4)**

b. Explain briefly two common problems associated with using maximal length PN codes. **(4)**

c. Explain with the aid of diagrams how a spread spectrum system can be achieved using frequency hopping. **(6)**

d. Sketch the output of a DSSS system where the input is the data signal 10101 and the spreading sequence is a 4 bit PN code at two times the frequency of the data signal. **(6)**

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