Data Provided: None

The University Of Sheffield.

DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

Spring Semester 2015-2016 (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. Explain the difference between fixed and variable length coding schemes. **(3)**

b. Explain with the aid of diagrams why more bandwidth is needed in digital communications compared to analogue communications. **(4)**

c. Find the Huffman codes for the following set of messages

Message	S_1	S_2	S_3	S_4
Probability	0.45	0.2	0.1	0.25

What is the percentage efficiency of this coding scheme? **(6)**

d. Derive an expression for the mean noise power, N_i, in an AM communication system. **(7)**

2. a. Explain how the information content of a message is linked to the probability of that message. **(3)**

b. Explain with the aid of diagrams how additive white Gaussian noise causes random errors in digital communication systems. **(5)**

c. Consider the convolutional encoder shown in Figure 1. Assume the shift register is initialised with 110:

i. Find the output sequence for an input bit sequence of 10010110.

ii. Draw the state diagram of this encoder.

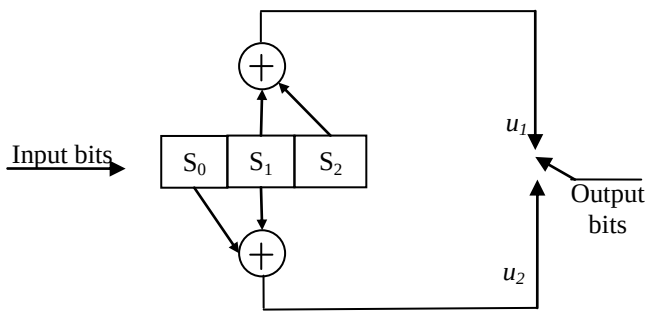

Figure 1

(6)

d. A communication system consists of three possible messages. The probabilities of the first and second messages are equal and given by p. Plot the entropy as a function of p. **(6)**

3. a. Explain briefly what is meant by encryption in a digital communication system. **(4)**

b. Explain whether the use of fast frequency hopping in preference to slow frequency hopping is justified when the bit error probability over a channel is very low. **(4)**

c. Explain with the aid of an example why synchronization is required when using a matched filter to detect PCM codewords. **(6)**

d. Explain with the aid of an example how a matched filter can be used to detect a particular signal shape. **(6)**

4. a. Explain briefly the characteristics of a good pseudo noise sequence. **(4)**

b. Using diagrams as necessary, explain why the bit error performance of Multiple Phase Shift Keying (MPSK) is degraded when the number of phases is increased (i.e. k is increased). Why might an engineer still choose to increase k? **(4)**

c. Using diagrams as necessary, explain how a data sequence can be spread using a direct sequence spread spectrum (DSSS) system. **(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)**

SK/KG