

EEE 317 Tutorial questions – Source and Channel encoding

- 1) State the equation to calculate the entropy in a system with N messages.
- 2) We have a message set as follows; 000, 001, 010, 011, 1110, 1101, 1110, 1111. At the receiver, we receive, in turn, the bits 1,1,0,1. Plot the value of H for each of the successive bits on the graph of entropy.
- 3) Write down the equation to calculate the average bit error rate in a binary system in terms of the probability of obtaining a false 1 and a false 0.
- 4) Name two types of error which might occur on a channel, and give an example of how one might incur such an error.
- 5) What is the aim of Huffman coding?
- 6) Derive the Huffman code for the following message set, $a \rightarrow f$.
$$p(a) = 0.02$$
$$p(b) = 0.42$$
$$p(c) = 0.05$$
$$p(d) = 0.25$$
$$p(e) = 0.23$$
$$p(f) = 0.03$$
- 7) An optical telecommunication system has $p(\text{false } 1) = p(\text{false } 0) = 10^{-9}$, and is used to transmit 12 bit-long code-symbols. How many code words will be transmitted on average before the system will suffer
 - a) a 1 bit error
 - b) a 2 bit error
- 8) If the letters in the English language has the following probability of occurrence,

a, e, t, s	$p = 0.065$
r, n, m, l, d, g	$p = 0.05$
o, u, h, c, i, p, b	$p = 0.04$
q, w, y, j, k, z, x, v	$p = 0.02$

Calculate the entropy transmitted by sending a single letter.

- 9) A communications channel has pdfs for signal amplitude when a 1 and a 0 is transmitted as follows.

$$p_0(a) = \begin{cases} \frac{|0.1 - a|}{5 \times 10^{-3}} & 0 < a < 0.1 \\ 0 & \text{elsewhere} \end{cases}$$

$$p_1(a) = \begin{cases} \frac{|a - 0.08|}{5 \times 10^{-3}} & 0.08 < a < 0.18 \\ 0 & \text{elsewhere} \end{cases}$$

determine the optimum decision threshold, a_m by inspection of the pdfs, the probability of a false 1 and false 0. Assuming that 60% of the pulse train is composed of digital '1's, calculate the average error probability.

- 10) Draw the state diagram of the following convolutional encoder.

