ENEE 420
FALL 2007

COMMUNICATIONS SYSTEMS

HOMEWORK # 2
Due October 3, 2007

Please work out the **ten** (10) attached problems. **Show** work and **explain** reasoning. Three (3) problems, selected at random amongst these ten problems, will be graded.

1. ___

Design a Huffman code for the source $X = (\mathcal{X}, \boldsymbol{p})$ where $\mathcal{X} = \{1, \ldots, n\}$ for some positive integer n and

$$p(x) = 2^{-x}, \quad x = 1, \ldots, n-1, \; p(n) = 2^{-(n-1)}$$

Is the entropy bound achieved in this case?

2. ___

Consider the code $C : \mathcal{X} \to \mathcal{B}^\star$ for a seven symbol source given by

$$01, 100, 101, 1110, 1111, 0011, 0001$$

Show that this code cannot be a Huffman code for any source $X = (\mathcal{X}, \boldsymbol{p})$.

3. ___

Exercise 9.9 (Haykin, p. 620)

4. ___

Exercise 9.10 (Haykin, p. 620)

5. ___

Exercise 9.11 (Haykin, p. 620)

6.

Exercise 9.12 (Haykin, p. 620)

7.

Exercise 9.14 (Haykin, p. 621)

8.

Consider the four symbol source $X = (\mathcal{X}, \boldsymbol{p})$ with $\mathcal{X} = \{A, B, C, D\}$ and pmf $\boldsymbol{p} = (p(A), p(B), p(C), p(D))$. Find a pmf $\boldsymbol{p}$ for which there exist two optimal codes which assign different codeword lengths to the four symbols.

9.

Find sources $X = (\mathcal{X}, \boldsymbol{p})$ for which the difference between its entropy and the expected codeword length of the Huffman code is as large as possible.

10.

Exercise 9.16 (Haykin, p. 621)