

# Principles of Communications

## Chapter I: Introduction – Homework

October 29, 2013

**1.1** The probability of occurrence for letter E in English alphabet is maximal, and equals 0.105. Find its information content?

**1.2** An information source consists of A, B, C and D. Assume each symbol occurs independently, and the occurrence probabilities are respectively  $1/4$ ,  $1/4$ ,  $3/16$ , and  $5/16$ . Find the information content for each symbol in information source.

**1.3** An information source consists of A, B, C and D. The symbols are represented by binary codeword 00, 01, 10, and 11. If each binary symbol is transmitted by the pulse with width 5 ms, then find the average information rates respectively under the following conditions:

- (1) The 4 symbols have equal probability of occurrence.
- (2) The 4 symbols have the probabilities of occurrence as given in Exercise 1.2

**1.4** What is the symbol rate in the above exercise?

**1.5** Assume an information source consists of 64 different symbols, the occurrence probability of 16 symbols among them is  $1/32$ , and the occurrence probability of other 48 symbols is  $1/96$ . If there are only thousand independent symbols per second sent out, find the average information rate of the information source.

**1.6** Assume a signal source produces 4-ary signals with equal probability, and the width of its symbol is  $125 \mu\text{s}$ . Find its symbol rate and information rate.

**1.7** Assume the equivalent resistance of the input circuit of a receiver is  $600 \Omega$ , the bandwidth of input circuit is equal to  $6 \text{ MHz}$ , and the environment temperature is  $23^\circ\text{C}$ . Find the effective thermal noise voltage produced by the circuit.

**1.8** Assume a wireless link uses line-of-sight propagation for communication, and the heights of the transmitting antenna and receiving antenna are both  $80 \text{ m}$ . Find the maximum communication distance.

**1.9** 已知某四进制数字传输系统的传信率为2400 b/s, 接收端在半小时内共收到216 个错误码元, 试计算该系统的误码率 $P_e$ 。

**1.10** 某系统经长期测定, 它的误码率为 $P_e = 10^{-5}$ , 该系统码元速率为1200 Bd, 问在多长时间可能收到360 个误码元。

**1.11** 若两个电阻的阻值为 $R_1 = 1000\Omega$ ,  $R_2 = 2000\Omega$ , 它们的温度分别为270 K 和290 K, 试分别计算两个电阻串联和并联后两端的噪声功率谱密度。

**1.12** 已知有线电话信道的带宽为3.4 kHz:

(1) 试求信道输出信噪比为30 dB 时的信道容量;

(2) 若要在该信道中传输33.6 kb/s 的数据, 试求接收端要求的最小信噪比为多少。

**1.13** 已知每张静止图片含有 $6 \times 10^5$  个像素, 每个像素具有16 个亮度电平, 且所有这些亮度电平等概率出现。若要求每秒钟传输24 幅静止图片, 试计算所要求信道的最小带宽(设输出信噪比为30 dB)。