## **Assignment of Chapter 3**

1. Given a random variable set of  $X = \{1, 2, 3, 4, 5, 6\}$  with probabilities

$$P = \left\{\frac{1}{3}, \frac{1}{3}, \frac{1}{5}, \frac{1}{15}, \frac{2}{45}, \frac{1}{45}\right\}.$$

Please

- (a) Construct its binary Shannon-Fano code.
- (b) Show that there exist two different binary Huffman coding schemes.
- (c) Find the expected code lengths for the above Shannon-Fano code and Huffman codes.
- 2. An instantaneous code has word lengths  $l_1, l_2, \ldots, l_m$ , which satisfy the strict inequality

$$\sum_{i=1}^m D^{-l_i} < 1.$$

The code alphabet is  $\mathcal{D} = \{0, 1, 2, ..., D - 1\}$ . Show that there exist arbitrarily long sequences of code symbols in  $\mathcal{D}$  that cannot be mapped into sequences of message symbols. Solution tip: Consider the *D*-ary tree structure.