Homework 3

1. Design a differential 8-PSK (D8PSK) communication scheme including transmitter and non-coherent receiver. Explain and show the mapping from information bits to phase of carrier at transmitter, and operation at the receiver from the received signal to final decoded bits. Assume rectangular pulse shape. From non-coherent receiver, you can understand that local oscillator pair at the receiver (for in-phase and quadrature branches) has a constant and unknown phase offset ϕ with respect to received signal. Without the knowledge of ϕ value, show how the receiver can decode original bits.

2. You are given 9 identical looking coins. One of the coins is heavier than the other 8. You are also given a balance scale. So you can only weight coins themselves in two sides of the scale to determine heavier side. You are asked to identify the heavier coin with minimum number of weighing as possible. Determine you strategy.
   a. How would weight the coins at first step: 4 vs 4 or 3 vs 3, or 2 vs 2, or 1 vs 1? Since you want to maximize the information you get at each step, go with the option that gives you maximum expected information content (entropy) by considering 3 possible outcomes of weighting as random events while determining the entropy. Determine the entropy of each choice of weighting above.
   b. Finish the strategy based on your selection in (a). What is the minimum number of weighting to determine the heavy coin?