EE 115 Lab 1

1) In this task, we will examine the average power of a random signal that has its minimum value larger than or equal to -1, and its impact on the power efficiency of the conventional AM signals.
   a) Use the Gaussian random generator to generate a random sequence $m[0], m[1], \cdots, m[N]$ where N could be 200 or some other large integer.
   b) Determine the minimum value of the sequence and denote it by $-M_0$.
   c) Compute the normalized sequence $m_n[k] = \frac{1}{M_0} m[k]$ whose minimum value should be now -1.
   d) Compute the average power of $m_n[k]$ by $P_m = \frac{1}{N} \sum_{k=1}^{N} m_n^2[k]$.
   e) If we apply the conventional AM to $m_n(t) = m_n[k] rect(t - kT)$ where $rect(t)$ is a rectangular pulse of width equal to T , the transmitted signal is

$$u_{AM}(t) = A_c(a_{mod} m_n(t) + 1) \cos(2\pi f_c t) \tag{1}$$

   and then its power efficiency is

$$\eta_{AM} = \frac{a_{mod} P_m}{1 + a_{mod} P_m}. \tag{2}$$

   Plot η_{AM} versus $0 < P_m < 1$ for each of $a_{mod} = 1, 0.75, 0.5$.

2) In this task, we will examine the quality of a simple DC blocker which consists of a capacitor C and a resistor R (in serial connection). We know that the frequency response $H(f)$ of the DC blocker is

$$H(f) = \frac{j2\pi f}{j2\pi f + \frac{1}{RC}} \tag{3}$$

   a) Plot $|H(f)|$ versus $-50 < f < 50$ in Hz for each of $RC = 0.01, 0.1, 1, 10$.
   b) If we want to remove the DC component from $a_{mod} m_n(t) + 1$ where the spectrum of $m_n(t)$ occupies the band from 20Hz to 5kHz, what should be an acceptable range of the RC values? (Provide a proper minimum value of RC.)