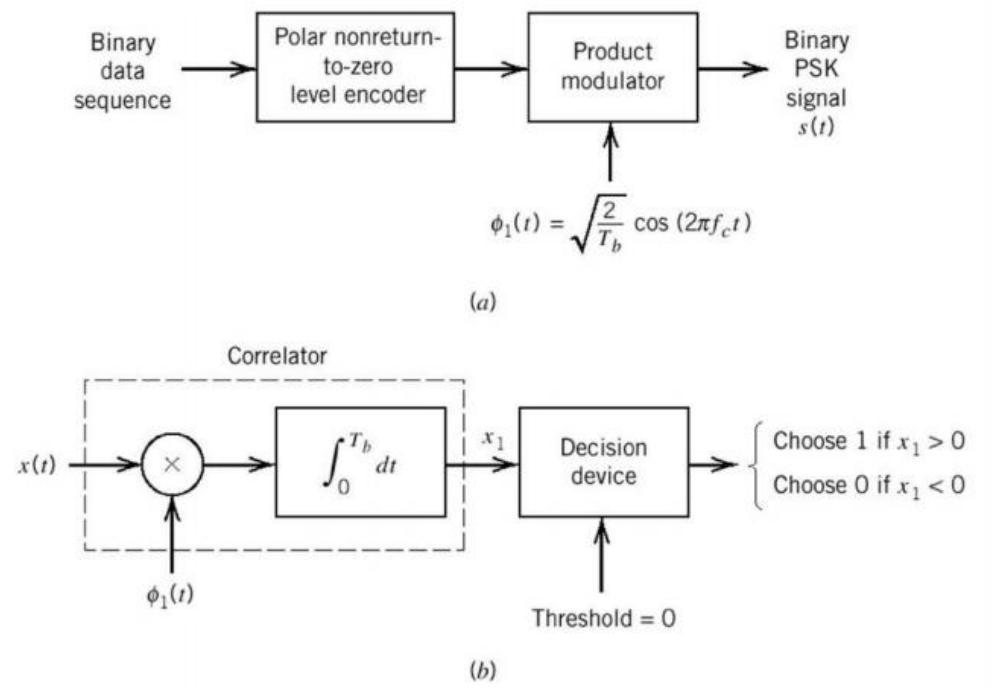
HW2 – BPSK

Objective:

In this homework, you will be asked to implement the Generation and detection of BPSK by the following step:



(1) Generate 10^4 bits of binary random numbers.

(2) Modulate the binary numbers with BPSK, given that the carrier frequency f_c is 1 MHz, and the symbol energy E_b is 2 dB and frequency is 1 KHz.

(3) Demodulate the transmitted signal using the block diagram above.

(4) Add the demodulated samples by AWGN noise $N(0,\frac{N0}{2})$, with N_0=1.

(5) Do symbol detection on the resultant samples.

(6) Calculate the BER.

(7) Redo the same experiments with 0 dB $\leqq$ E_b $\leqq$ 10 dB.

(8) Draw and compare the BER with the theoretical values.

Note that the theoretical bit error rate (BER) of BPSK is (on pp. 26 of the Unit 4 lecture material)

$$p_e = \frac{1}{2}\operatorname{erfc}\left(\sqrt{\frac{E_b}{N_0}}\right)$$

Hint

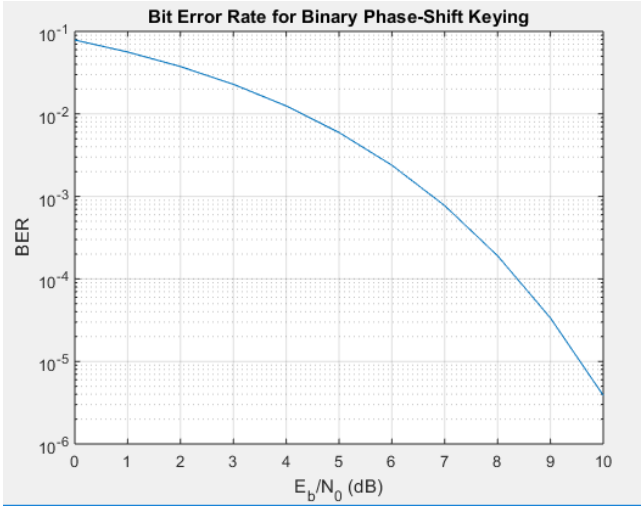
1. Since the frequency is 1 KHz, which means that it transmits 10^3 bits per second.
2. In this lab, your t should be a vector [0, T_s, 2*T_s …], and your sample time slot(T_s) should smaller than $\frac{1}{fc}$, i.e. $\frac{1}{2*fc}$ is fine.
3. You should generate more bits of binary random numbers when the E_b increases.
   Suggested: 10^4 bits when 0dB $\leqq$ E_b $\leqq$ 4 dB
   10^5 bits when 5dB $\leqq$ E_b $\leqq$ 8 dB
   10^6 bits when 9dB $\leqq$ E_b $\leqq$ 10 dB
4. At step(7), you can use $\pm\sqrt{Eb}$ to replace the integration of s(t).It will reduce much execution time.

- The received signal is given by $x(t) = s_i(t) + w(t)$, and
  $x_1 = \int_0^{T_b} x(t)\phi_1(t)dt = \pm\sqrt{E_b} + \int_0^{T_b} w(t)\phi_1(t)dt$
- The sampled noise
  $w_1 = \int_0^{T_b} w(t)\phi_1(t)dt$

What to turn in

A XXX.zip file containing (XXX is your student ID):

1. Your source codes (in matlab or any other you want). Make sure it works.
2. Readme (describe how to execute your program. This could be either .txt or .doc file)
3. Report (.doc file please)
   Briefly explain what you did and show your BER picture like this.



Deadline

5/25 (Fri) 23:59

Hand in late is not allowed/此份作業不能遲交