Exercise Sheet 2 : Fundamental Circuits for Telecommunication Systems

Exercise 1

For the **system 1** : $m(t) = A_m \cos \omega_m t$, $c_1(t) = A_1 \cos \omega_1 t$ and $c_2(t) = \cos \omega_2 t$, while : $f_m << f_1$ and $f_1 < f_2$.

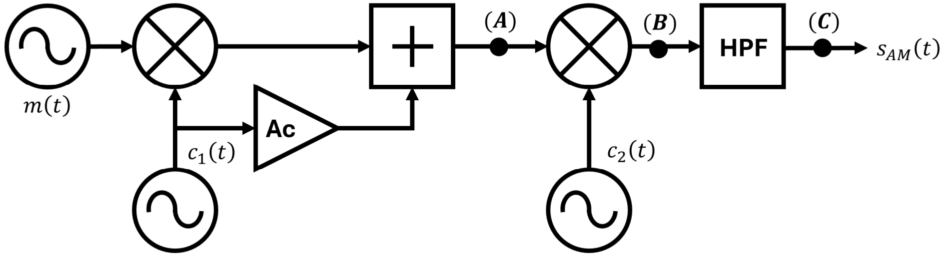

Figure 1: System 1

1. Calculate the signal at point (A) and sketch its spectrum.
2. Calculate the signal at point (B) and sketch its spectrum.
3. If the cut-off frequency of the HPF is defined as $f_{CO} = f_1$, deduce the expression of the signal $s_{AM}(t)$ assuming $\omega_2 + \omega_1 = \omega_c$.
4. Sketch the spectrum for $s_{AM}(t)$.

For the **system 2** we give : $L(t) = \cos \omega_L t$, $I(t) = \cos \omega_I t$, the center frequency of the BPF is : $f_I = f_C + f_L$ and the cut-off frequency of the LPF is f_m .

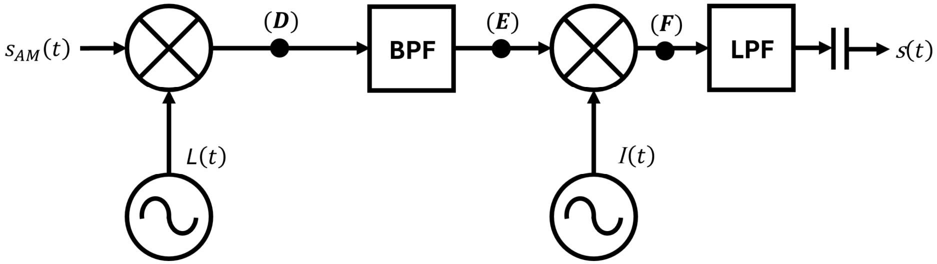

Figure 2: System 1

5. Calculate $s(t)$.
6. Sketch the spectrum for points (D), (E), and (F).

Exercise 2

1. Determine the expression for the transfer function of the filter below and its cutoff frequency.

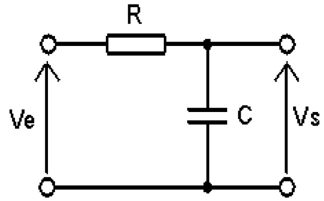

Figure 3: System 1

2. Sketch its response.

We want to design a filter with a cutoff frequency of 10 kHz. If $R = 820\,\Omega$, calculate the value of the inductance L.

3. A signal with an amplitude of 2V and a frequency f is injected at the input of the circuit.
4. Does the signal pass through the filter if $f = 1\,\text{kHz}$ or $15\,\text{kHz}$?
5. Calculate the amplitude of the signal at the output in each case.
6. Calculate f such that the output signal amplitude $V_s = 0.5\,\text{V}$.