EPITA / InfoS2 May 2018

NAME: ..... Firstname: ..... Group: .....

# Electronics Final Exam

*Calculators and extra documents are not allowed. The marking scale is given as a rough guide.*

***Please answer only on exam sheets. If more space is needed, write on the back.***

## Exercise 1. MCQ (5 points – no negative points)

Choose the correct answer (there may be more than one answer).

We want to identify an unknown dipole. We measure the voltage $u(t)$ at its terminals and the current $i(t)$ which flows through it. We get:

$$u(t) = 15\,sin(\omega t) \text{ and } i(t) = 7{,}5.10^{-3}\,cos(\omega t + \phi) \text{ with } \omega = 2000\,rad.s^{-1}$$

1. If $\phi = 0$, this dipole is:

   a. A resistor $R = 2k\Omega$

   b. A coil of inductance $L = 1\,H$

   c. A resistor $R = 0{,}5\Omega$

   d. A capacitor of capacitance $C = 0{,}25\mu F$

2. If $\phi = -\frac{\pi}{2}$, this dipole is:

   a. A resistor $R = 2k\Omega$

   b. A coil of inductance $L = 1\,H$

   c. A resistor $R = 0{,}5\Omega$

   d. A capacitor of capacitance $C = 0{,}25\mu F$

3. If $\phi = -\pi$, this dipole is:

   a. A coil of inductance $L = 2\,H$

   b. A capacitor of capacitance $C = 0{,}25\mu F$

   c. A capacitor of capacitance $C = 2\mu F$

   d. None of the above

4. What is the unit of $LC\omega^2$?

   a. Farad b. Siemens c. Without unit d. Ohm

The transfer function of a 2nd order filter can be written as:

$$\underline{T} = A_0 . \frac{\underline{Num}(\omega)}{1 + 2.j.\sigma.\frac{\omega}{\omega_0} - \left(\frac{\omega}{\omega_0}\right)^2}$$

5. If $\underline{Num}(\omega) = 2.j.\sigma.\frac{\omega}{\omega_0}$, then this filter is:

   a. High-pass b. Low-pass c. Band-pass d. Band-stop

6. If $\underline{Num}(\omega) = 1$, then this filter is:

   a. High-pass b. Low-pass c. Band-pass d. Band-stop

7. If $\underline{Num}(\omega) = -\frac{\omega^2}{\omega_0^2}$, then this filter is:

   a. High-pass b. Low-pass c. Band-pass d. Band-stop

8. For a low-pass filter of second order $A_0$ is the amplification in the low frequency regime.

   a. TRUE b. FALSE

9. For a high-pass filter of second order $A_0$ is always the maximal amplification.

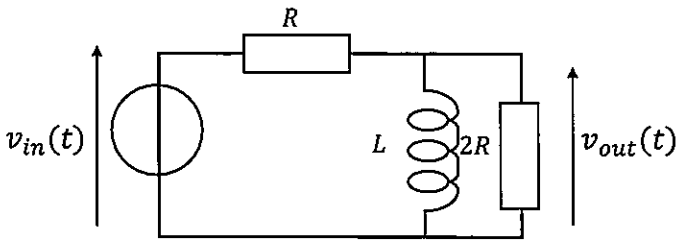
   a. TRUE b. FALSE

10. For a band-pass filter of second order $A_0$ is the amplification in the high frequency regime.

    a. TRUE b. FALSE

## Exercise 2. First order filter (7,5 points)

Consider the following circuit:




1. Qualitative study: Find the limits of the gain function for $f \to 0$ and for $f \to \infty$. Deduce which kind of filter we are considering.

2. Determine its transfer function. Deduce the phase shift of the voltage $v_{out}$ if compared with $v_{in}$.

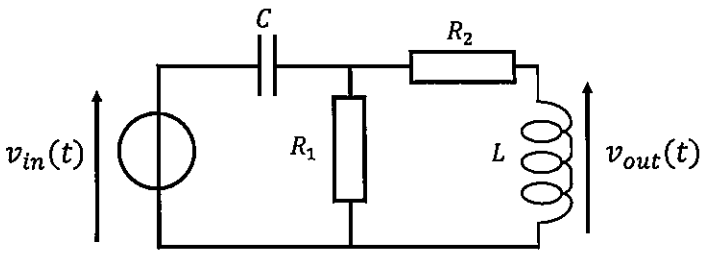
3. Determine the cut-off pulsation.

4. Bode's diagrams. Draw the curves of the gain and the phase. You will detail the limits of the gain and the phase, both in the low and high frequency regime. Furthermore, determine the equation of the oblique asymptote for the gain curve.

5. Which kind of filter do we get if the self is replaced by a capacitor? Explain your answer. (You don't need to study the circuit from the beginning again).

## Exercise 3. Study of a 2nd order filter (7,5 points)

Consider the following circuit:




1. Qualitative study: Find the limits of the gain function for $f \to 0$ and for $f \to \infty$. Deduce which kind of filter we are considering.

2. Determine its transfer function and write it in the normalized form. Consider the case with $R_1 = R_2 = R$.

3. Which kind of filter do we get if $L$ and $R_1$ are exchanged? Explain your answer. (You don't need to study the circuit from the beginning again).

4. We consider the initial circuit. If $v_{in}(t) = V_{IN}.cos(\omega t)$, determine the expression of $v_{out}(t)$. Consider, as in question 2, $R_1 = R_2 = R$.