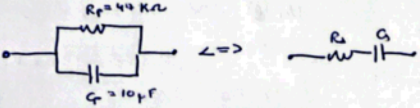
$\boxed{P8} \rightarrow$ T.4

no se puede ya que a $f = 50$ Hz



a) $f = 1000$ Hz

b) $f = 10\,000$ Hz

$$Z_{paralelo} = R_p \parallel \frac{1}{j\omega C_p} \rightarrow \frac{1}{Z_p} = \frac{1}{R_p} + j\omega C_p \rightarrow Z_p = \frac{R_p}{1 + j\omega C_p R_p}$$

multiplicando arriba y abajo por $(1 - j\omega C_p R_p)$

$$Z_{serie} = R_s + \frac{1}{j\omega C_s} = R_s - j/\omega C_s$$

$$Z_p = \frac{R_p - j\omega R_p^2 \cdot C_p}{1 + \omega^2 \cdot R_p^2 \cdot C_p^2}$$

$$\rightarrow Z_p = \frac{R_p}{1 + \omega^2 R_p^2 C_p^2} - \frac{\omega R_p^2 C_p}{1 + \omega^2 R_p^2 C_p^2}$$

$$Z_s = R_s - j/\omega C_s$$

$\rightarrow$ Igualando ambas impedancias, las reales con las reales y las imaginarias con la imaginaria

$\Rightarrow$ Dependiente de la frecuencia

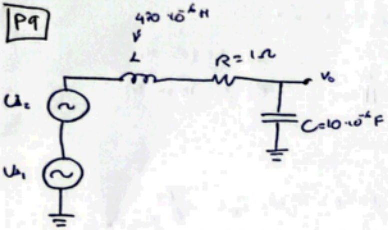
$$\text{Real} \rightarrow R_s = \frac{R_p}{1 + \omega^2 \cdot R_p^2 \cdot C_p^2} \quad (1) \qquad \text{Im} \rightarrow \frac{1}{\omega C_s} = \frac{\omega R_p^2 \cdot C_p}{1 + \omega^2 \cdot R_p^2 C_p^2} \quad (2)$$

sustituimos y hallamos R_s y C_s en cada caso (1) y (2)

a) $f = 1000$ Hz $\rightarrow \omega = 2\pi \cdot 10^3\ s^{-1} \rightarrow R_s = 4323\ \Omega,\ C_s = 124'6$ nF

b) $f = 10000$ Hz $\rightarrow \omega = 2\pi \cdot 10^4\ s^{-1} \rightarrow R_s = 493'3\ \Omega \quad C_s = 11'15$ nF

P9

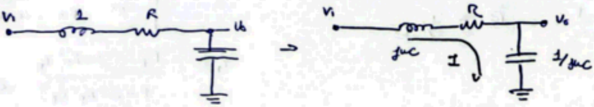


$u_{s1}(t) = 300 \sin(2\pi f_1 t)$ V

$u_{s2}(t) = 60 \sin(2\pi f_2 t + 27°)$ V

$f_1 = 1000$ Hz

$f_2 = 10\,000$ Hz



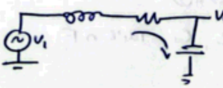
$$\frac{\tilde{V}_o}{V_i} = \frac{1/j\omega C}{\frac{1}{j\omega C} + jL\omega + R} = \frac{1}{1 - LC\omega^2 + j\omega RC} = T(\omega)$$

Forma polar $T(\omega)$

$$\tilde{V}_o = \tilde{V}_i \cdot T(\omega) \to T(\omega) = |T(\omega)| \angle \varphi_T = \frac{1}{\sqrt{(1-LC\omega^2)^2 + (\omega RC)^2}} \angle 0 - \tan^{-1}\left(\frac{\omega RC}{1-LC\omega^2}\right)$$

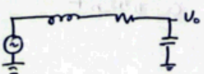
~~Sustituyendo obtenemos T(ω)~~

Al tener 2 fuentes de tensión aplicamos el principio de superposición;



$V_1 = 300 \angle 0° \to V_{o1} = 300\,V \angle 0° \times T(\omega_1) \to$ Sustituimos

$300\,V \angle 0° \cdot 1'2242 \angle -4'41° = \boxed{367'26\,V \angle -4'41}$

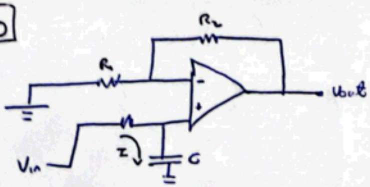


$V_2 = 60 \angle 27° \to V_{o2} = 60 \angle 27 \times T(\omega_2)$

$60 \angle 27° \cdot (0'0569 \angle -177.45°) = \boxed{3'414\,V \angle -150'45°}$

V_o será la suma de ambas $\Rightarrow$ $\boxed{v_o(t) = 367'26 \sin(2\pi f_1 t - 4'41) + 3'414\,V(\sin(2\pi f_2 t - 150'45)}$

P10



R = 5300 Ω | R1 = 10 KΩ

C = 10 nF | R2 = 27 KΩ

f=3000Hz

$V_{in} = 1V \sin(2\pi \cdot 3000\,Hz \times t)$

$$V^+ = V_{in}\frac{Z_c}{R+Z_c} = V_{in}\frac{1/j\omega C}{R+1/j\omega C} = \frac{V_{in}}{1+j\omega RC}$$

$$\frac{V_{out}-V^-}{R_2} = \frac{V^- - 0}{R_1} \Rightarrow V_{out} = V^-\left(1+\frac{R_2}{R_1}\right)$$

$$V^+ = V^- \Rightarrow V_{out} = \left(1+\frac{R_2}{R_1}\right)\cdot\frac{1}{1+j\omega RC}V_{in}$$

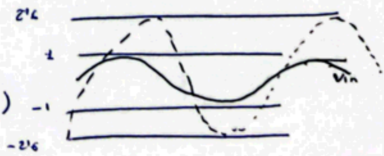
$V_{in} = 1V \angle 0°$

$$\left(1+\frac{R_2}{R_1}\right)\frac{1}{1+j\omega RC} = \left(1+\frac{27}{10}\right) = \frac{1}{1+j\underbrace{2\pi\,3000\cdot 5300\,\Omega\cdot 10\cdot 10^{-9}\,F}_{0'999}}$$

$$= \frac{1+27/10}{\sqrt{1+(0'999)^2}}\angle 0 - \tan^{-1}(0'999)$$

$V_{out} = 2'6176V \angle -44'97°$

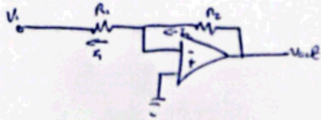
$V_{out} = 2'6176V \cdot \sin(2\pi \cdot 3000 - 44'97°)$



$\omega T = 360° \Rightarrow \frac{\varphi}{\omega T} = \frac{45}{360} = 1/8$ se desfasa 1/8

13.1

$\boxed{P11}$



$Ad_0 = 200\,000 \rightarrow$ DC en lazo

$f_0 = 5\,Hz \rightarrow$ fuente

$$Ad(f) = \frac{Ad_0}{1+j\,f/f_0}$$

Ganancia amplificador V_o/V_i en función de f

$R_1 = 8200\ \Omega \qquad R_2 = 220\,000$

$$I_1 = I_2 \rightarrow \frac{V^- - V_i}{R_1} = \frac{V_o - V^-}{R_2} \rightarrow \frac{R_2}{R_1}(V^- - V_i) = (V_o - V^-)$$

$$V_o = V^-\left(1+\frac{R_2}{R_1}\right) - V_i\,\frac{R_2}{R_1}$$

$$V_o = Ad\,(V^+ - V^-) = -Ad\,V^- \rightarrow V^- = -V_o/Ad \rightarrow \text{en } V^- \text{ análisis}$$

$\hookrightarrow V^+ = 0 \rightarrow$ masa

$$V_o = -\frac{V_o}{Ad}\cdot\left(1+\frac{R_2}{R_1}\right) - V_i\cdot\frac{R_2}{R_1} \rightarrow V_o\cdot\left[1+\frac{1+R_2/R_1}{Ad}\right] = -V_i\,\frac{R_2}{R_1}$$

$$\frac{V_o}{V_i} = \frac{-R_2/R_1}{1+\frac{1+R_2/R_1}{Ad}} \Rightarrow \frac{-R_2/R_1}{1+\left(1+\frac{R_2}{R_1}\right)\cdot\frac{1+j\,f/f_0}{Ad_0}}$$ sustituimos

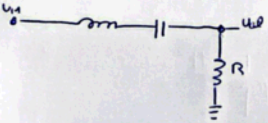
$$\boxed{G = \frac{V_o}{V_i} = \frac{-220/8'2}{1+\frac{1+\frac{220}{8'2}}{200\,000} + j\,\frac{f\cdot\left(1+\frac{220}{8'2}\right)}{200\,000\cdot 5}}}$$

P12 $V_{in} = 5V$

$R = 4'7\,\Omega$
$L = 22\,\mu H$
$C = 100\,nF$

$f_0 = 110$ KHz
$f_0 = 63$ KHz
$f_0 = 36$ KHz

$f = 30$ KHz
$f_0 = 22$ KHz
$f_0 = 16$ KHz



Sabiendo que n es el nº de armónico, los coeficientes de fourier son:

$$V_n = \frac{4\,V_{in}}{n\pi} \cdot \sin\left(\frac{n\pi}{2}\right)$$

La ganancia vendrá dada por la función de transferencia según la frecuencia
Como las impedancias están en serie

$$Z(f) = R + j\left(\omega L - \frac{1}{\omega C}\right) \rightarrow |Z(f)| = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

Sabiendo que $H(f) = \frac{V_{out}}{V_{in}} = \frac{1}{|Z(f)|} = \frac{1}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)}}$

Si queremos usar

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

$$H = \frac{1}{\sqrt{1 + \left(\frac{f}{f_0} - \frac{f_0}{f}\right)\frac{R^2}{L^2}}}$$

Ahora calculamos los armónicos para cada f

	V_n	$H(f)$	V_{out}
~~$f_0 = 110$ KHz~~	~~6'17662~~		
~~$f_1 = 110$ KHz~~	6'3662	0'2933	2'5958 ✓
$f_3 = 3 \cdot 110 = 330$ KHz	~~0'1243~~ 2'12	0'06447	~~$4'266 \cdot 10^{-3}$~~ ✓
$f_5 = 5 \cdot 110 = 550$ KHz	~~0'17977~~ 1'2732	0'01367	~~$2'1227 \cdot 10^{-3}$~~ ✓

$f_0 = 110$ kHz

	V_n	H_z	$V_{at} = \frac{V_n \cdot H_z}{[illegible]}$
$f_1 = 110$ KHz	6'3662	0'2102	1'3382
$f_3 = 330$ KHz	2'1221	0'02435	0'051677 V^{-3}
$f_5 = 550$ KHz	1'2732	0'01365	0'017379 ^{-3}V

$f_1 = 63$ Hz	6'3662	0'05811	0'3699 V
$f_3 = 189$ Hz	2'1221	0'05492	0'11655 V
$f_5 = 315$ H	1'2732	0'025789	0'03285 V

$\boxed{P13}$ $f_0 = 12\,KHz$ $Q = 10$ $H_0 = 5$ $V_s = 0'8\,V$ $f = 4\,KHz$

$$V_s(t) = \frac{4V_s}{\pi}\left(\sin(\omega_1 t) + \frac{\sin(\omega t\,3)}{3} + \frac{\sin(5\omega t)}{5} \dots\right)$$

$$V_s = \frac{4\,0'8}{\pi}\cdot \sin(2\pi 4000\,t + \emptyset) + \frac{\sin(2\pi 3\cdot 4000\,t + 0)}{3}$$

$$H(\omega) = \frac{H_0\,\frac{j\omega}{Q\omega_0}}{1-\left(\frac{\omega}{\omega_0}\right)^2 + j\frac{\omega}{Q\omega_0}} \rightarrow |H(\omega)| = \frac{H_0\,\frac{\omega}{Q\cdot\omega_0}}{\sqrt{\left(1-\left(\frac{\omega}{\omega_0}\right)^2\right)^2 + \left(\frac{\omega}{Q\omega_0}\right)^2}}$$

$$V_{o_n} = V_{s_n}\,|H(\omega)|$$

$$\text{Calculo } H(4000) = \frac{5\cdot\frac{2\pi\cdot 4000}{10\cdot 2\pi\,12000}}{\sqrt{\left(1-\left(\frac{2\pi\cdot 4000}{2\pi\cdot 12000}\right)^2\right)^2 + \left(\frac{2\cdot\pi\cdot 4000}{10\,\pi\,2\,12000}\right)^2}} = 1'8737$$

$$|H(12000)| = 50$$

$$\text{Calculo } V_{s_n} \rightarrow V_{s_n} = \frac{4\cdot V_s}{\pi n}\cdot \sin\left(\frac{n\pi}{2}\right)$$

$$V_{s_1} = \frac{4\cdot 0'8}{\pi} = 1'019$$

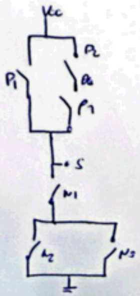
$$V_{s_3} = \frac{4\cdot 0'8}{3\pi}\sin\left(\frac{3\pi}{2}\right) = 16'977$$

$$V_{o_T} = V_{o_1} + V_{o_3} = 17'885\ V$$

Desfase ϕ = arctg $\dfrac{Im[H(\omega)]}{Re[H(\omega)]} = \dfrac{5 \cdot f \frac{4}{12} \sqrt{1+(4/10.1)^2}}{1'8737} = 87'85°$

$$\boxed{V_S = 1'8737 \cdot \sin(2\pi \cdot 4000 \cdot t + 87'85) + 16'977 \sin \sin(2\pi \cdot 12000\, t + 0°)}$$

P14



P W_1, P_1 cab. = ε_1

W_2, P_2 cabe = ε_2

W_3, P_3 cabo = ε_3

Olivos y segunda fuera 3,1x

S_1 $S = 0 \rightarrow$ tierra

$S = 1 \rightarrow$ Vcc

Re $S = 0 \rightarrow W_1$ cerrado y W_2 o W_3 cerrados o ambos

W1 AND (N2 o N3)

Al orden atacar por ε_1

ε_1 AND (ε_2 or ε_3)

Ok ✓

ε_1	ε_2	ε_3	ε_2 or ε_3	ε_1 AND ε_2 or ε_3
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	0	0
1	0	1	1	1
1	1	0	1	~~0~~ 1
1	1	1	1	1

* Tabla lógica OR

E_2	E_3	E_2 or E_3
0	0	0
0	1	1
1	0	1
1	1	1

[illegible]

Para $S=1$ → la salida lógica será la negación de la función dada para $S=0$

$$\overline{E_1 \wedge (E_2 \vee E_3)}$$

E_1 AND (E_2 OR E_3)	$\overline{E_1 \text{ AND} (E_2 \text{ OR } E_3)}$
0	1
0	1
0	1
0	1
1	0
1	0
1	0
1	0

Como se ve en la tabla lógica sólo nos quedamos $S=1$ porque es el estado activo del circuito donde se realiza la función lógica, los casos $S=0$ no son representativos