Nombre: .... Sección: ....

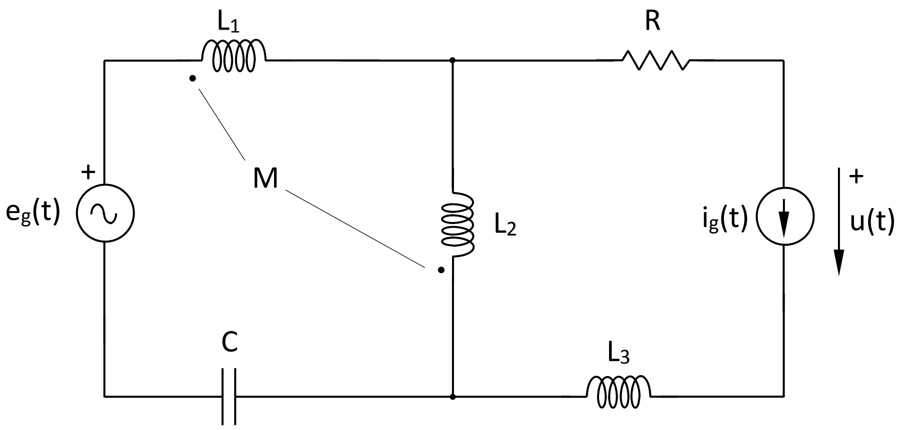
Primera convocatoria curso 2021_22 (9/junio/2022)

Prueba corta 4.

Dado el circuito de la figura, que se encuentra en régimen estacionario, determinar la tensión u(t). (10 ptos)

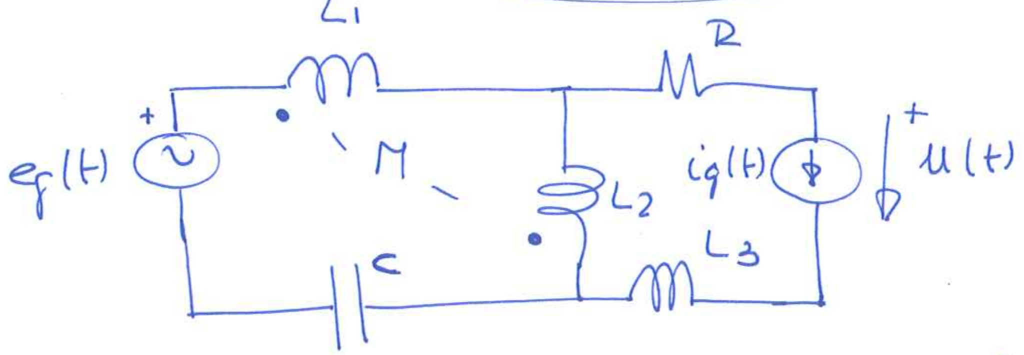
<u>Datos</u>: L_1 = 150 mH, L_2 = 100 mH, M = 50 mH, L_3 = 20 mH, R = 12 Ω, C = 5 mF,

$e_g(t) = 37\sqrt{2}\cos(10t - \pi/6)$ V , $i_g(t) = 20\sqrt{2}\cos(100t + \pi/2)$ A .



1ª CONVOCATORIA. - CURSO 2021/22. 9/06/2022

PRUEBA 4.



$L_1 = 150\ mH$, $L_2 = 100\ mH$, $M = 50\ mH$, $L_3 = 20\ mH$, $R = 12\Omega$,

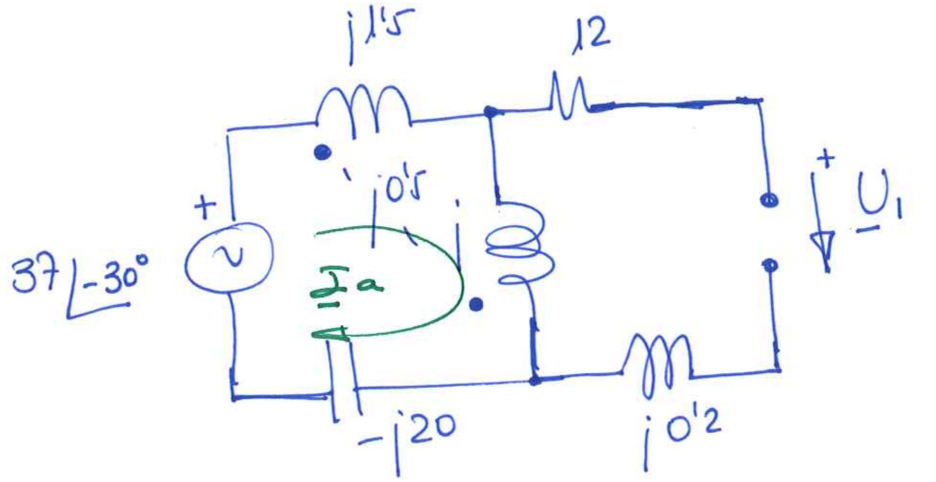
$C = 5\ mF$, $e_g(t) = 37\sqrt{2}\cos(10t - \pi/6)\ V$, $i_g(t) = 20\sqrt{2}\cos(100t + \pi/2)$

El circuito contiene 2 fuentes sinusoidales. La fuente de tensión pulsa a $\omega_1 = 10$ rad/s y la fuente de intensidad pulsa a $\omega_2 = 100$ rad/s.

Para aplicar el método simbólico es IMPRESCINDIBLE aplicar el teorema de SUPERPOSICION

SUBCIRCUITO 1: Actúa la fuente de $\omega_1 = 10$ rad/sg. Apagamos la fuente de intensidad.

Se pasa el circuito al campo complejo:



$j\omega_1 L_1 = j\,10 \cdot 150 \cdot 10^{-3} = j1'5$

$j\omega_1 L_2 = j\,10 \cdot 100 \cdot 10^{-3} = j$

$j\omega_1 M = j\,10 \cdot 50 \cdot 10^{-3} = j0'5$

$j\omega_1 L_3 = j\,10 \cdot 20 \cdot 10^{-3} = j0'2$

$-j\dfrac{1}{\omega_1 C} = -j\dfrac{1}{10 \cdot 5 \cdot 10^{-3}} = -j20$

Análisis por mallas:

$$j1'5\,\underline{I}a - j0'5\cdot\underline{I}a + j\,\underline{I}a - j0'5\,\underline{I}a - j20\,\underline{I}a = 37\angle{-30^\circ}$$

$$(j1'5 - j0'5 + j - j0'5 - j20)\,\underline{I}a = 37\angle{-30^\circ}$$

$$-j18'5\,\underline{I}a = 37\angle{-30^\circ}$$

$$\underline{I}a = \frac{37\angle{-30^\circ}}{18'5\angle{-90^\circ}} = 2\angle{60^\circ}$$

$$\underline{U}_1 = -j0'5\,\underline{I}a + j\,\underline{I}a = j0'5\,\underline{I}a = 0'5\angle{90^\circ}\cdot 2\angle{60^\circ} =$$

$$= 1\angle{150^\circ}$$

$$\underline{U}_1 = 1\angle{150^\circ}\ \text{V}$$

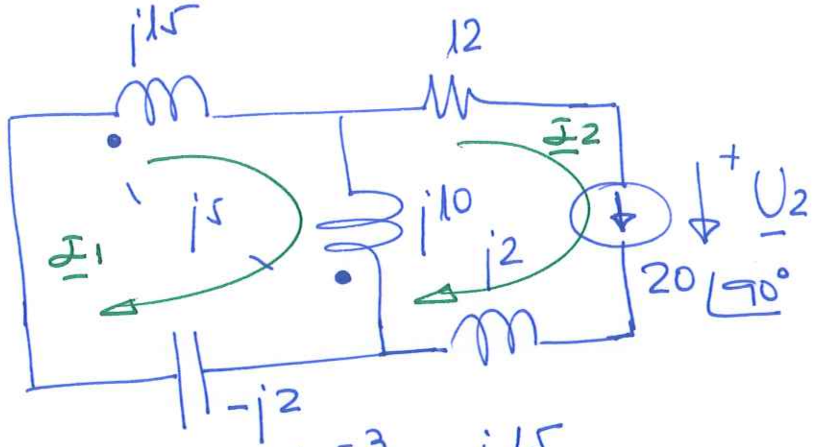
$$u_1(t) = 1\cdot\sqrt{2}\,\cos(10t + 0'833\pi)$$

$$u_1(t) = \sqrt{2}\,\cos(10t + 0'833\pi)$$

SUBCIRCUITO 2: Actúa la fuente de $\omega_2 = 100$ rad/s

Apagamos la fuente de tensión.

Se pasa el circuito al campo complejo:



$$j\omega_2 L_1 = j\,100 \cdot 150 \cdot 10^{-3} = j15$$
$$j\omega_2 L_2 = j\,100 \cdot 100 \cdot 10^{-3} = j10$$
$$j\omega_2 M = j\,100 \cdot 50 \cdot 10^{-3} = j5$$
$$j\omega_2 L_3 = j\,100 \cdot 20 \cdot 10^{-3} = j2$$
$$-j\frac{1}{\omega_2 C} = -j\frac{1}{100 \cdot 5 \cdot 10^{-3}} = -j2$$

Análisis por mallas:

Malla 1)

$$j15\,\underline{I}_1 - j5(\underline{I}_1 - \underline{I}_2) + j10(\underline{I}_1 - \underline{I}_2) - j5\,\underline{I}_1 - j2\,\underline{I}_1 = 0$$

Malla 2)

$$12\underline{I}_2 + \underline{U}_2 + j2\,\underline{I}_2 + j10(\underline{I}_2 - \underline{I}_1) + j5\,\underline{I}_1 = 0$$

Ec. adicional: $\underline{I}_2 = 20 \angle 90°$

$$(j15 - j5 + j10 - j5 - j2)\,\underline{I}_1 + (j5 - j10)\,\underline{I}_2 = 0$$

$$j13\,\underline{I}_1 - j5\,\underline{I}_2 = 0$$

$$\underline{I}_1 = \frac{j5}{j13}\,\underline{I}_2 = 0'3846\,\underline{I}_2 = 0'3846 \cdot 20\angle 90^\circ = 7'692\angle 90^\circ$$

$$\underline{I}_1 = 7'692\angle 90$$

$$(12 + j2 + 10)\,\underline{I}_2 + (-j10 + j5)\,\underline{I}_1 = -\underline{U}_2$$

$$\underline{U}_2 = -(12 + j12)\,\underline{I}_2 + j5\,\underline{I}_1$$

$$\underline{U}_2 = -(12 + j12)\,20\angle 90^\circ + j5\,\underline{I}_1$$

$$\underline{U}_2 = -339'411\angle -45^\circ - 38'46 =$$

$$= 240 - j240 - 38'46 = 201'54 - j240.$$

$$\underline{U}_2 = 313'398\angle -49'970^\circ$$

entonces: $u_2(t) = 313'398\sqrt{2}\cos\left(100t - \frac{49'97}{180}\pi\right)$

Aplicando superposición: $u(t) = u_1(t) + u_2(t)$

$$u(t) = \sqrt{2}\cos(10t + 0'833\pi) + 313'398\sqrt{2}\cos(100t - 0'2776\pi)$$