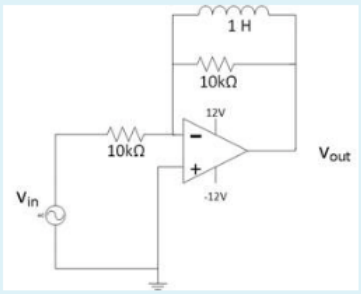


Q1h

Given V_{in} = 10 cos(20,000t).

What is the steady state output V_{out} ?

State your answer in the rectangular form Real + j Imaginary.

V_{out} = -8 ✔ +j -4 ✔ V

$Z_L = j\omega L = j(1)(20\,000) = j20K$

$10K\Omega \,//\, Z_L = \frac{(10K)(j20K)}{10K+j20K} = \frac{j200K}{10+j20}\cdot\frac{10-j20}{10-j20} = \frac{4000K+j2000K}{500}$

$= 8K+j4K$

NODE V_n : $\frac{V_n^{\circ}-V_{in}}{10K} + \frac{V_n^{\circ}-V_o}{8K+j4K} = 0$ $\qquad V_{in} = 10\angle 0^{\circ} \approx 10$

$-\frac{V_{in}}{10K} - \frac{V_o}{8K+j4K} = 0$

$V_o = -\frac{(10)(8K+j4K)}{10K} = -8-j4$

$I_1 = 5A \approx 5+j0\ A$ $\qquad V = 20\angle 45^{\circ} \approx 10\sqrt{2}+j10\sqrt{2}$

I_2 : $-50(I_2-I_1) - 75(I_2-I_3) - (10\sqrt{2}+j10\sqrt{2}) = 0$

$50I_1 - 125I_2 + 75I_3 = 10\sqrt{2}+j10\sqrt{2}$

$-125I_2 + 75I_3 = -250+10\sqrt{2}+j10\sqrt{2}$

I_3: $-j12I_3 - 75(I_3-I_2) + j20(I_3-I_1) = 0$

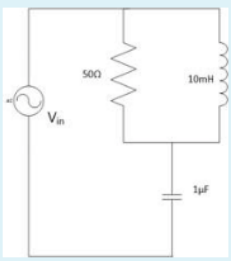
$-j20I_1 + 75I_2 + (-75+j8)I_3 = 0$

$75I_2 + (-75+j8)I_3 = j100$

$I_2 = \frac{j100}{75} + \left(\frac{75-j8}{75}\right)I_3$

$-125I_2 + 75I_3 = -250+10\sqrt{2}+j10\sqrt{2}$
$75I_2 + (-75+j8)I_3 = j100$

$I_2 = 5.069 - j1.434$
$I_3 = 5.304 - j2.202$



Q3c

Given V_{in} = 22 cos (10,000 t)

Find the steady state phasor current "through" the 1 μF (micro F) capacitor.

State your answer with the smallest appropriate positive angle.

$I_{1\mu F}$ (polar form) = Magnitude 0.25 ✔ Phase 63.43 ✔ ° (Degree) Amps

$V_{in} = 22$

$Z_L = j\omega L = j(10K)(10\times10^{-3}) = j100$

$50\Omega \,//\, 10mH = \frac{(50)(j100)}{50+j100}\cdot\frac{50-j100}{50-j100} = \frac{5000+j250\,000}{12\,500} = 40+j20$

$Z_C = \frac{-j}{\omega C} = \frac{-j}{(10\,000)(1\times10^{-6})} = -j100$

$V = IR \longrightarrow I_{1MF} = \frac{22}{40+j20-j100} = \frac{22}{40-j80}\cdot\frac{40+j80}{40+j80}$

$= \frac{880+j1760}{8000} = 0.11+j0.22$

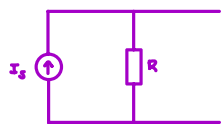
$I_{1MF} = 0.11+j0.22 \approx 0.25\angle 63.43^{\circ}$

$Z_C = \frac{-j}{\omega C} = \frac{-j}{(10\,000)(10\times10^{-6})} = -j10$

$Z_L = j\omega L = j(10\,000)(1\times10^{-3}) = j10$

$V = IR$

$I_s = \frac{V_{in}}{R} = \frac{30}{50-j10+j10} = 0.6$



$R \,//\, j10 = \frac{(50-j10)(j10)}{50-j10+j10} = \frac{100+j500}{50} = 2+j10$

$Z_{TH} = R_{eq} = 20+j10$

$V_{TH} = I_s R = (0.6)(j10) = j6$

$2.31+j1.69$

$v = 240\cos[90-(377t)]$

$= 240\cos(377t - 90°)$

$= 240\angle -90°$

$i = 6\angle -85°$

$P = V_{eff} I_{eff} \cos(\theta_v - \theta_i)$

$= (240)(6)\cos(-90° + 85°)$

$Q = V_{eff} I_{eff} \sin(\theta_v - \theta_i)$

$= (240)(6)\sin(-90° + 85°) =$

$S = V_{eff} \cdot I_{eff}$

$V = 120\angle -25°$

$i = 7\angle 25°$

$pf = \cos(\theta_v - \theta_i)$

$= \cos(-25 - 25) = 0.64$

(a) $I_{rms} = I_{max}/1.732 = 200/1.732 = 115.47\ mA$

$P_{avg} = (I_{rms})^2 \cdot R = (115.47)^2(5) =$

$I_{rms} = \frac{I_p}{\sqrt{3}} = \frac{200}{\sqrt{3}} = 115.47\ mA$

$P_{avg} = (I_{rms})^2 \cdot R = (115.47 \times 10^{-3})^2(5000) = 66.67\ W$