Nonlinear resistor and harmonics

**3.** Let $v$ be the voltage across the nonlinear resistor whose characteristic is

$$v = 50i^3$$

Calculate the voltage $v$ when a current $i = 0.01 \cos 377t$ flows through the nonlinear resistor (express the result as a sum of sinusoids). What frequencies are present in the output?

Imaginary natural frequencies and steady-state response

**8.** The circuit shown in Fig. P7.8 is made of linear time-invariant elements. The input is $e_s$, and the response is $v_C$. Knowing that $e_s(t) = \sin 2t$ volts, and at time $t = 0$ the state is $i_L = 2$ amp and $v_C = 1$ volt, calculate the complete response.
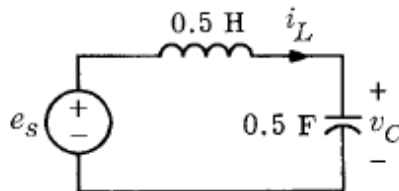


**Fig. P7.8**

Phasor diagram

**15.** Assuming $v_C(t) = \cos 2t$, construct a phasor diagram showing all voltages and currents indicated (see Fig. P7.15). Find the sinusoidal steady-state voltage $e_1(t)$. (Express it as a real-valued function of time.)
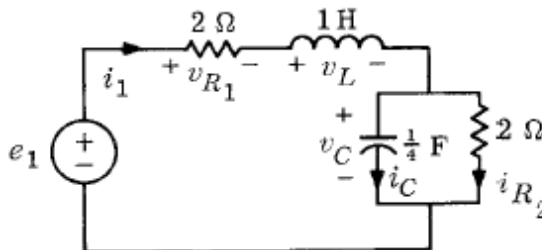


**Fig. P7.15**

Ladder circuit and network functions

**19.** For the ladder circuit shown in Fig. P7.19,

a. Determine the driving point admittance $Y(j\omega)$.

b. Calculate the steady-state current $i_1$ due to the sinusoidal voltage source $e_s(t) = 2 \cos 2t$.

c. Determine the transfer admittance $Y_{21}(j\omega) = I_2/E_s$ where $I_2$ and $E_s$ are phasors which represent the sinusoidal current $i_2$ and sinusoidal voltage $e_s$, respectively.

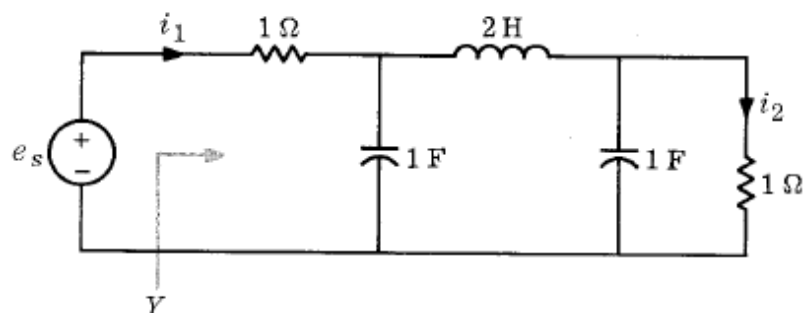d. Calculate the steady-state current $i_2$.

Fig. P7.19

Mesh analysis **22.** Determine the sinusoidal steady-state current in the inductor and the sinusoidal steady-state voltage across the 1-farad capacitor for the circuit shown in Fig. P7.22. The input voltage source is $e_s(t) = \cos 2t$.
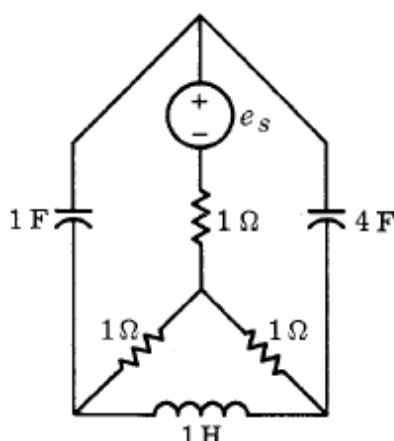


Fig. P7.22

Node analysis **23.** Change the series connection of the voltage source and the resistor in the circuit of Fig. P7.22 to the parallel connection of a current source and a resistor. Use node analysis to determine the sinusoidal steady-state current in the inductor and the sinusoidal steady-state voltage across the 1-farad capacitor.

تمرین کامپیوتری:

۱- با استفاده از اسپایس مسأله **8** را حل کنید.

۲- با استفاده از اسپایس مسأله **22** را حل کنید. (برای تحلیل **ac**)

۳- با استفاده از متلب مسأله **22** را حل کنید. (برای حل معادلات)