1. (18 pts)
   a) Find $V_{in}$ in polar form.
   b) Find $I_T$ in polar form.
   c) Circle 1:
      i) The source current leads the source voltage
      ii) The source voltage leads the source current

2. (15 pts) a) Find the s-type transfer function of the circuit shown. $V_i$ is the input and $V_o$ is the output.
   You MUST show work to get credit.
   Simplify your expression for $H(s)$ so that the denominator is a simple polynomial beginning with $s^2$.
   $H(s) = ?$
   b) Find the characteristic equation of the circuit shown.
   c) The solutions to the characteristic equation are called the ___________ of the transfer function.
   d) Does the transfer function have one or more zeros? If yes, express it (them) in terms of $R_1, R_2, C,$ & $L$.

3. (20 pts) Analysis of a circuit (not pictured) yields the characteristic equation below.
   
   $0 = s^2 + 500s + 62500$

   Further analysis yields the following initial and final conditions:
   
   $i_L(0) = 50 \text{ mA}$, $v_L(0) = -9 \text{ V}$, $v_C(0) = 4 \text{ V}$, $i_C(0) = 80 \text{ mA}$
   
   $i_L(\infty) = 110 \text{ mA}$, $v_L(\infty) = 0 \text{ V}$, $v_C(\infty) = 12 \text{ V}$, $i_C(\infty) = 0 \text{ mA}$

   Write the full expression for $i_L(t)$, including all the constants that you find. $i_L(t) = ?$
   Include units in your answer

4. (10 pts) For waveform shown, find:
   a) Average DC ($V_{DC}$) value
   b) RMS (effective) value
5. (13 pts) The transformer shown in the circuit below is ideal. It is rated at 120/12 V, 8 VA, 60 Hz. Find the following:

a) \( I_1 = ? \)

b) \( V_2 = ? \)

6. (24 pts) Consider the circuit at right. The switch has been in the closed position for a long time and is open (as shown) at time \( t = 0 \).

\( I_S := 300\text{-mA} \)

a) What are the final conditions of \( i_L \) and the \( v_C \)?

\( i_L(\infty) = ? \) \( v_C(\infty) = ? \)

b) Find the initial condition and initial slope of \( v_C \) that you would need to have in order to find all the constants in \( v_C(t) \). Don't find \( v_C(t) \) or it's constants, just the initial conditions.

c) Find the initial condition and initial slope of \( i_L \) that you would need to have in order to find all the constants in \( i_L(t) \). Don't find \( i_L(t) \) or it's constants, just the initial conditions.

Answers

1. a) \( V_{in} = 3.6\text{V} /-36.9^\circ \)  
   b) \( I_T = 154\text{mA} /-27.9^\circ \)  
   c) i) \(-27.9^\circ > -36.9^\circ \)

2. a) \[
\frac{s^2 + \frac{R_2}{L}s}{s^2 + \left(\frac{R_1 + R_2}{L}\right)s + \frac{1}{L\cdot C}}
\]
   b) \( 0 = s^2 + \left(\frac{R_1 + R_2}{L}\right)s + \frac{1}{L\cdot C} \)
   c) poles  
   d) \( 0 \) and \( \frac{R_2}{L} \)

3. \( i_L(t) := 110\text{-mA} - 60\text{-mA}e^{-250t \text{sec}^{-1}} - 29\frac{A}{\text{sec}^{-1}} t e^{-250t \text{sec}^{-1}} \)

4. a) 0\text{-V}  
   b) 4.9\text{-V}  

5. a) 40\text{-mA}  
   b) 8\text{-V}  

6. a) 300\text{-mA}  
   b) 20\text{-V} \( \frac{V}{\text{sec}} \)  
   c) 100\text{-mA} \( \frac{A}{\text{sec}} \)