1. (10 pts) Find the resonant frequency (or frequencies) of the circuit shown (in cycles/sec or Hz).

\[ L_1 := 3 \text{ mH} \quad R := 60 \Omega \quad C_1 := 4 \mu\text{F} \quad C_2 := 6 \mu\text{F} \quad L_2 := 4.5 \text{ mH} \]

2. (30 pts) The switch has been closed (making contact) for a long time and is switched open (as shown) at time \( t = 0 \).
   a) Find the complete expression for \( v_C(t) \).
   b) What is \( v_C \) when \( t = 1.5\tau \)? \( v_C(1.5\tau) = ? \)
   c) At time \( t = 1.5\tau \) the switch is closed again. Find the complete expression for \( v_C(t') \), where \( t' \) starts at \( t = 1.5\tau \).
      Be sure to clearly show the time constant.

3. On next page (out of order)

4. (23 pts) a) Find \( V_{in} \).
   b) Find \( Z_2 \) in polar form.
   c) Circle 1: i) The source current leads the source voltage   ii) The source voltage leads the source current
   d) By how much? I.E. what is the phase angle between the voltage and current?
3. (18 pts) Find $Z_{eq}$ in simple polar form (give me numbers).

For partial credit, you must show work and/or intermediate results.

$$f = 31.831 \text{ Hz}$$

5. 19 pts) The voltage across a capacitor is shown below. Make an accurate drawing of the capacitor current. Make reasonable assumptions where necessary. Label your graph.

Note: You will be graded on the accuracy of your plot at 0, 2, 6 and 8 ms, so calculate those values and plot or label them carefully. Between those points your plot must simply be the correct shape.

You MUST SHOW how you calculate your values starting from the original relationships between voltage and current. That is: Start with the integer and/or differential equations for the capacitor!

Answers

1. 581-Hz
2. a) $3.6 \cdot V + 5.4 \cdot V \cdot e^{-\frac{1}{151 \mu s}}$
   b) $4.8 \cdot V$
   c) $9 \cdot V - 4.2 \cdot V \cdot e^{-\frac{1}{54 \mu s}}$

3. 26.25 $\Omega$ / -17.75°
4. a) $15.2 V / 23.2^\circ$
   b) $46.2 / 79.7^\circ$ $\Omega$
   c) ii) d) $23.2^\circ$

5. i

$$i_{C} (mA)$$