Problem 1:

For the circuit shown in the figure

\[ R=10, \quad L=2 \text{ H}, \quad \text{and} \quad C=\frac{1}{50} \text{ F} \]

1) Find the input impedance \( Z_{in}(j\omega) \) (3 points)

2) Find the input admittance \( Y_{in}(j\omega) \) (4 points)

3) Find the resonance frequency. (3 points)

4) Find the quality factor of the circuit. (2 bonus)

\( \text{(Hint: assume that you have a voltage test source and then use source transformation)} \)

Simplify \( Z_{in}(j\omega) \) & \( Y_{in}(j\omega) \) as real +j imaginary

Problem 2:

A 10 Ω resistor and a 2 H inductor are connected in parallel and \( \omega=50 \text{ rad/s} \).

(a) What is the \( Q \) of this parallel connection?

(b) What series RL connection has the same impedance as the parallel connection at the given frequency?

(c) What is the \( Q \) of this series connection?

(d) A circuit has the following transfer function, \( H(j\omega) = \frac{V_{out}}{V_{input}} = \frac{1}{2 + j\omega} \), find the cutoff frequency for this circuit.

Problem 3:

For the circuit shown in the figure, the resonance frequency is \( 6/\sqrt{10} \text{ rad/s} \), to find the quality factor we have applied a test current source of value \( 1 Angle 0^\circ \text{ A} \), and we have found that the current through the 4H inductor is \( I_2 = 2 Angle 0^\circ \text{ A} \), the voltage across the capacitor can be found to be \( 6\sqrt{10} Angle -90^\circ \text{ V} \). Find the quality factor

\( \text{Hint: continue to find the current in the other inductors.} \)

\[ \cos^2 \theta = \frac{1}{2}(1 + \cos 2\theta) \]

Good Luck, Dr. Ali Muqaibel