Benha University | **Electrical Circuits (2)** | **Electrical Eng. Dept.**
Faculty of Engineering | | **1st year communication**
Shoubra | | **1-3 March 2015**

Sheet (2)... Series Resonance

1. A series RLC network has R=2kΩ, L=40 mH, and C=1μF. Calculate the impedance at resonance and at one-fourth, one-half, twice, and four times the resonant frequency.

   (Ans. 2K, 2-j0.75KΩ, 2-j0.3KΩ, 2+j0.3KΩ, 2+j0.75KΩ).

2. A coil with resistance 3Ω and inductance 100 mH is connected in series with a capacitor of 50 pF, a resistor of 6Ωand a signal generator that gives 110 V rms at all frequencies. Calculate ωo, Q, and B at resonance of the resultant series RLC circuit.

   (Ans. 447.21 krad/s , 4969 , 90 rad/s).

3. Design a series RLC circuit with B=20 rad/s and ω_0=1000 rad/s. Find the circuit's Q.

   (Ans. = Q =50, assume R=10Ω, so L= 0.5H , C= 2μ F).

4. Consider the circuit of Figure 1
   a. Determine the values of R and C such that the circuit has a resonant frequency of 25 kHz and an rms current of 25 mA at resonance.
   b. Calculate the power dissipated by the circuit at resonance.
   c. Determine the phasor voltages, V_C, V_L, and V_R at resonance.

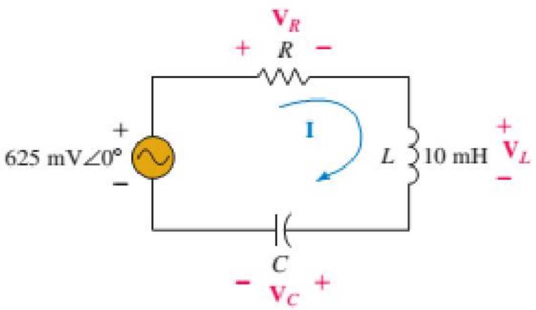

Figure (1)

(Ans. a- R=25Ω, C=4.05nF /// b- P=15.6mW /// c- V_C=39.3∠-90 , V_L=39.3∠90 , V_R=0.625∠0)

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5. Refer to the circuit of Figure 2.
   a. Determine the resonant frequency expressed as ω (rad/s) and f(Hz).
   b. Calculate the total impedance, Z_T, at resonance.
   c. Solve for current I at resonance.
   d. Solve for V_R, V_L, and V_C at resonance.
   e. Calculate the power dissipated by the circuit and evaluate the reactive powers, Q_C and Q_L.
   f. Find the quality factor, Q_S, of the circuit.

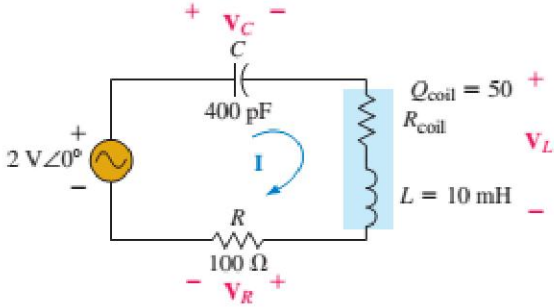

Figure (2)

(Ans. a- ω_S=500Krad/s, fs=79.6KHz /// b-Zt=200∠0 /// C- I=10mA∠0 /// d- V_R=1∠0 , V_L =50.01∠88.85, V_C=50∠-90 /// e- Pt=20mW /// f- Qs=25).

6. Refer to the circuit of Figure 3.
   a. Find ω_S, Q, and BW (in radians per second).
   b. Calculate the maximum power dissipated by the circuit.
   c. From the results obtained in (a) solve for the approximate half-power frequencies, ω1 and ω2.
   d. Calculate the actual half-power frequencies, ω1 and ω2, using the component values and the appropriate equations.

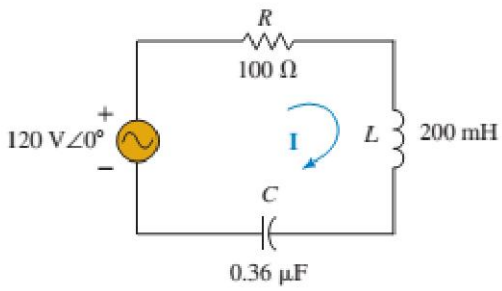

Figure (3)

(Ans. a- ω_S=3727rad/s, Q=7.45, BW=500rad/s /// b- Pmax=144W /// C- w1=3477rad/s , w2=3977rad/s /// d- w1=3485.2rad/s , w2=3985rad/s)

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Home Assignment (1):

1. For the circuit in Fig. 4, find the frequency ω for which v (t) and i (t) are in phase.

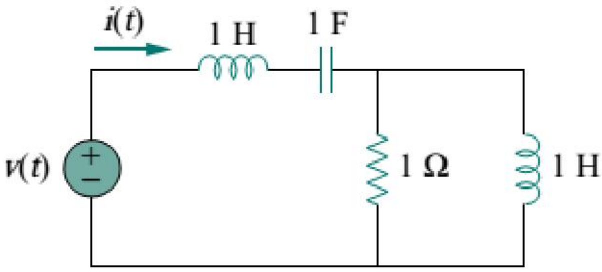

Figure (4)

2. Refer to the series resonant circuit of Figure 5.
   a. Determine the resonant frequency, ω_S.
   b. Solve for the input impedance, $Z_T = Z\angle\theta$, of the circuit at frequencies of 0.1 ω_S, 0.2 ω_S, 0.5 ω_S, ω_S, 2 ω_S, 5 ω_S, and 10 ω_S.
   c. Using the results from (b), sketch a graph of Z (magnitude in ohms) versus ω (in radians per second) and a graph of θ (in degrees) versus ω (in radians per second).
   d. Using your results from (b), determine the magnitude of current at each of the given frequencies.
   e. Use the results from (d) to plot a graph of I (magnitude in amps) versus ω (in radians per second).

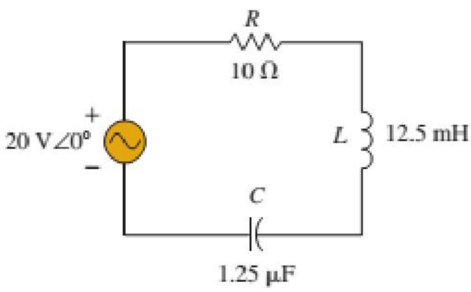

Figure (5)

Good Luck

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