ENSC 220 – Assignment #6 (Nov 21st, 2005; due Nov 28th, 2005)

1.

Find the impedance Z_{ab} in the circuit seen in Fig. **A** . Express Z_{ab} in both polar and rectangular form.

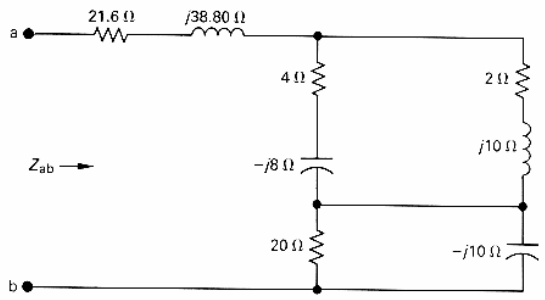

FIGURE A

2.

Find the admittance Y_{ab} in the circuit seen in Fig. **B** . Express Y_{ab} in both polar and rectangular form. Give the value of Y_{ab} in millimhos.

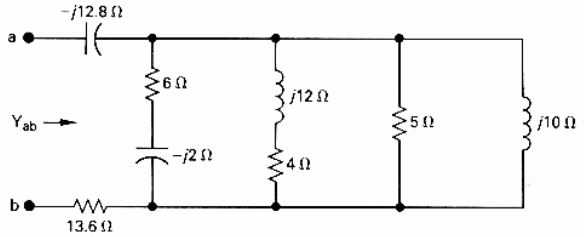

FIGURE B

3.

The current source in the circuit shown in Fig. **C** is generating a sinusoidal waveform such that $i_g = 20 \cos (40{,}000t - 73.74°)$ A. Find the steady-state expression for $v_o(t)$.

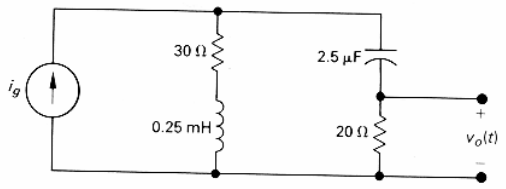

FIGURE C

4.

Find the steady-state expression for $v_o(t)$ in the circuit seen in Fig. **D** by using the technique of source transformations. The sinusoidal voltage sources are

$$v_1 = 400 \cos (5000t + 36.87°) \text{ V}$$

and

$$v_2 = 128 \sin 5000t \text{ V}.$$

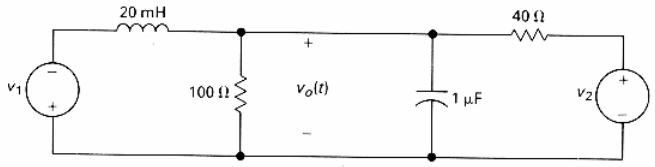

FIGURE D

5.

A resistor, denoted as R_l, is added in series with the inductor in the circuit in *(N/A)* . The new low-pass filter circuit is shown in Fig. **G** .

a) Derive the expression for $H(s)$ where $H(s) = V_o/V_i$.

b) At what frequency will the magnitude of $H(j\omega)$ be maximum?

c) What is the maximum value of the magnitude of $H(j\omega)$?

d) At what frequency will the magnitude of $H(j\omega)$ equal its maximum value divided by $\sqrt{2}$?

e) Assume a resistance of 75 Ω is added in series with the 250 mH inductor in the circuit in Fig. **G2** . Find ω_c, $H(j0)$, $H(j\omega_c)$, $H(j0.3\omega_c)$, and $H(j3\omega_c)$.

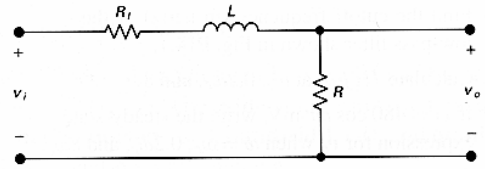

Figure G

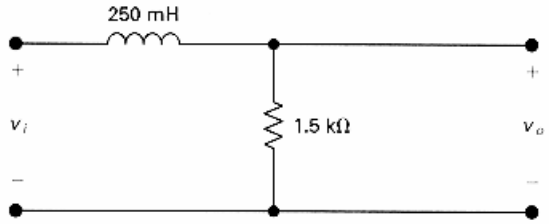

Figure G2

6.

A resistor, denoted as R_c, is connected in series with the capacitor in the circuit in Fig. **H2** . The new high-pass filter circuit is shown in Fig. **H** .

a) Derive the expression for $H(s)$ where $H(s) = V_o/V_i$.

b) At what frequency will the magnitude of $H(j\omega)$ be maximum?

c) What is the maximum value of the magnitude of $H(j\omega)$?

d) At what frequency will the magnitude of $H(j\omega)$ equal its maximum value divided by $\sqrt{2}$?

e) Assume a resistance of 10 kΩ is connected in series with the 2.5 nF capacitor in the circuit in Fig. **H3** Calculate ω_c, $H(j\omega_c)$, $H(j0.1\omega_c)$, and $H(j10\omega_c)$.

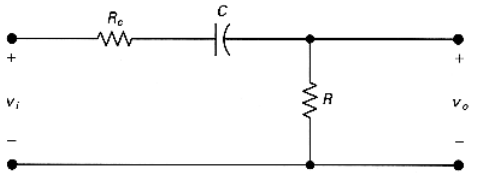

Figure H

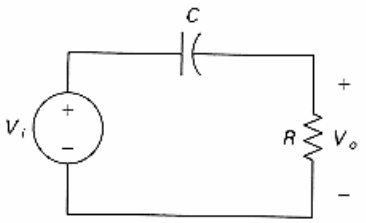

Figure H2

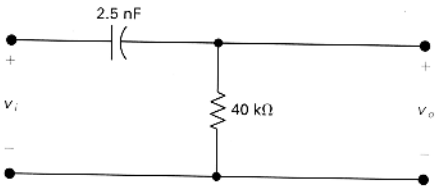

Figure H3

7.

The frequency of the sinusoidal voltage source in the circuit in Fig. **E** is adjusted until the amplitude of the sinusoidal output voltage is maximum. The maximum amplitude of the source voltage is 600 V.

a) What is the frequency of v_s in hertz?

b) What is the amplitude of v_o at the frequency given in part (a)?

c) What is the bandwidth of the circuit?

d) What is the Q of the circuit?

e) At what frequencies will the amplitude of v_o be $1/\sqrt{2}$ times its maximum value?

f) If the 20-kΩ resistor represents the internal resistance of the source, how much does this source resistance lower the Q of the circuit?

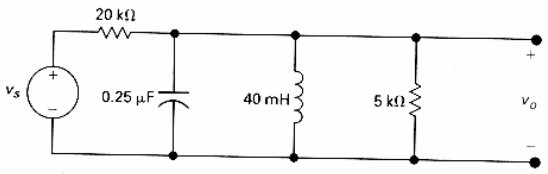

FIGURE E

8.

The sinusoidal voltage source in the circuit in Fig. **F** has a maximum amplitude of 50 V. The internal impedance of the source is negligible.

a) At what frequency is the amplitude of v_o maximum?

b) What is the maximum amplitude of v_o?

c) Over what range of frequencies will the amplitude of v_o be equal to or greater than 0.80 of its maximum value?

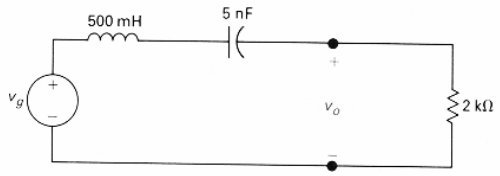

FIGURE F