EE 233 HW6

Updated on Nov 14th (band bass filter design problem is added)

Due Date: Nov 16th

Problems from text book (electric circuits, 10th version): **13.70, 13.80, 13.91**

Other problems are listed below

1. a) Use the convolution integral to find the output voltage of the circuit in Fig. 1 if the input voltage is the rectangular pulse shown in Fig. 2.
   b) Sketch $V_0(t)$ versus t for the time interval $0 \leq t \leq 10$ms.

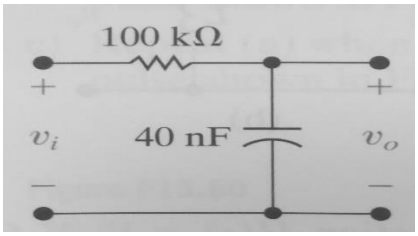

Fig. 1. Circuit

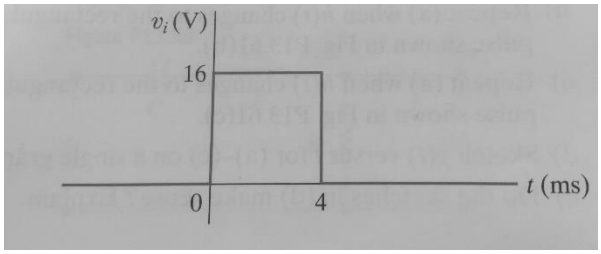

Fig. 2. Rectangular Pulse

2. A resistor denoted as R_l is added in series with the inductor in RL circuit. And the new low pass filter circuit is shown in the figure below.
   (a) Derive the expression for $H(s)$ where $H(s) = \dfrac{V_o(s)}{V_i(s)}$.
   (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 $75\,\Omega$ is added in series with the 10mH inductor in the circuit below (R=127 Ω, $R_l = 75\ \Omega$ in this case). Find ω_c, $H(j0)$, $H(j\omega_c)$, $H(j0.3\omega_c)$ and $H(j3\omega_c)$.

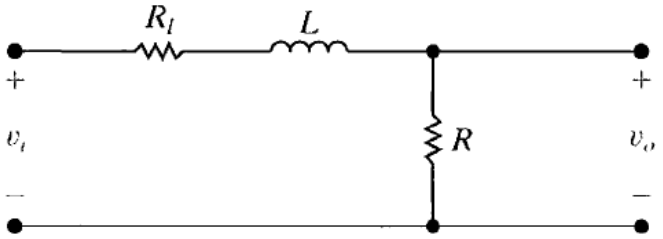

Fig.3

3. Using a 50 nF capacitor in the bandpass circuit shown in the figure below (figure 4), design a filter with a quality factor of 5 and a center frequency of 20 krad/s.
   a) Specify the numerical values of R and L.
   b) Calculate the upper and lower cutoff frequencies in kilohertz
   c) Calculate the bandwidth in hertz.

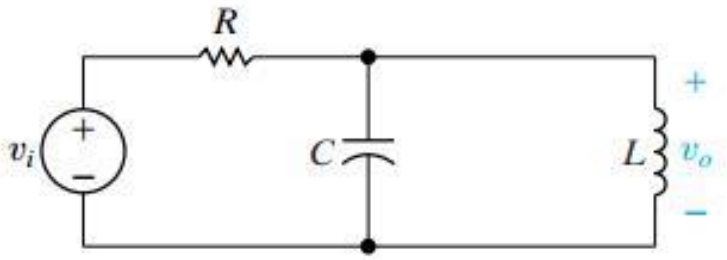

Fig.4