1. Please answer the following questions about the circuit in Fig. 1.
   (a) (10%) Suppose $E_1 = E_2 = 10\cos(10t)$, $R_1 = R_2 = \infty$, $L = 2$ H and $C = 0.02$ F, and initially $i(0) = 1$ A and $v(0) = 0$, what is the amplitude and oscillation frequency of the voltage $v(t)$ across the capacitor?
   (b) (10%) Suppose $E_1 = E_2 = 10\cos(10t)$, $R_1 = R_2 = 1\Omega$, $L = 2$ H and $C = 0.02$ F, and initially $i(0) = 1$ A and $v(0) = 0$, what is the current $i(t)$ through the inductor in steady state?
   (c) (10%) Suppose $E_1 = 10\cos(10t)$, $E_2 = 10\sin(20t)$, $R_1 = R_2 = 1\Omega$, $L = 2$ H and $C = 0.02$ F, and initially $i(0) = 1$ A and $v(0) = 0$, what is the average power dissipation on resistor R_2?
   (d) (10%) Suppose $E_1 = 10\cos(10t)$, $E_2 = 0$, $R_1 = 1\Omega$, and $C = 0.02$ F, what the values of L and R_2 should be chosen to achieve maximum average power delivered to resistor R_2? Also, what is the maximum average power delivered to R_2?
   (e) (10%) Suppose $R_1 = R_2 = 1\Omega$, $L = 2$ H and $C = 0.02$ F, what is the transfer function E_1 to i?

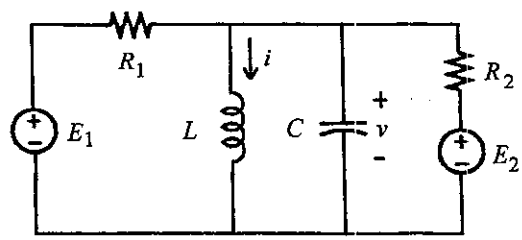

Fig. 1

2. (10%) For the transformer with L_1=0.001 H, L_2=0.1 H, M=0.01 H, and R=10 ohm, shown in Fig. 2, please find its input impedance function $Z(s)$.

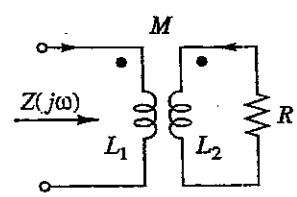

Fig. 2

3. For the circuit in Fig. 3, please answer the following question,
   (a) (10%) If the voltage across the capacitor is initially 1 volt, then, given input voltage $v_s = 2\sin(0.5t)$, what is the output voltage $v_o(t)$?
   (b) (10%) Is the active filter shown below highpass or lowpass? What is its cutoff frequency?
   (c) (10%) Scale the resistors and capacitor such that the resulting input impedance is 1000 times larger than the original one while maintaining the same transfer function.

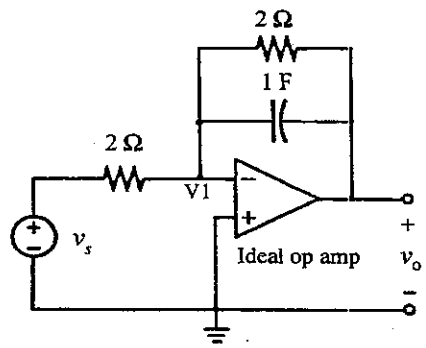

Fig. 3

4. (10%) Assume the equivalent circuit for the coil shown in Fig. 4 is a 2Ω resistor and 10mH inductor in series. Suppose the switch is closed for a long time, then what is the amount of energy stored in the coil? If the switch opened suddenly, would the voltage on the terminal B rise or fall?

Fig. 4