1. The *LRC* network shown in Fig. 1 has $R = 15\ \text{k}\Omega$, $C = 0.4\ \mu\text{F}$, $L = 1\ \text{mH}$. The current source, I, is a sinusoidal function with fixed amplitude of 2 mA and adjustable frequency. Answer the following questions.

(a) Determine the resonant frequency of the *LRC* network in radian frequency. [5]

(b) What is the quality factor of the *LRC* network? [5]

(c) Write down the time domain equation for the inductor current, $i_L(t)$, when the network is operated at resonant frequency. [10]

2. An audio amplifier shown in Fig. 2 is designed to produce $v_{out} = 2K\,v_{in}$, where K is a constant gain.

(a) Derive the expression of v_1 and v_2 in terms of K, R, R_a, and v_{in}. [10]

(b) Derive the expression of R_a in terms of R and K to meet the required output function. [10]

3. The circuit shown in Fig. 3 has DC input voltage $v_s(t) = 10$ V, when $t < 0$, and AC input voltage $v_s(t) = \sin t$ V when $t > 0$.

(a) Determine the capacitor voltage $V_c(s)$ in s-domain. [10]

(b) Determine the capacitor voltage, $v_c(0^+)$, at $t = 0^+$, and the derivative of the capacitor voltage, $v_c'(0^+)$, at $t = 0^+$. [10]

4. Answer the following questions:

(a) In Fig. 4, find the Norton's equivalent circuit with respect to the terminal a, b. [10]

(b) What is the maximum power that can be delivered to the load at terminal a, b? [10]

5. A motor is connected to a 240 V, 60 Hz source by a transmission line with resistance $R_{line} = 1\ \Omega$. The motor would draw 4.8 kW and has power factor pf = 0.5 lagging when operated at 240 V. By adding a parallel-connected capacitor to the motor, the line loss can be reduced.

(a) Find the equivalent impedance of the motor. [5]

(b) Determine the capacitance of the parallel-connected capacitor to minimize the line loss.[5]

(c) Calculate the power supplied by the source before and after the parallel-connected capacitor is installed. [10]

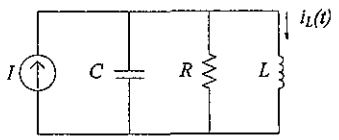

Fig. 1

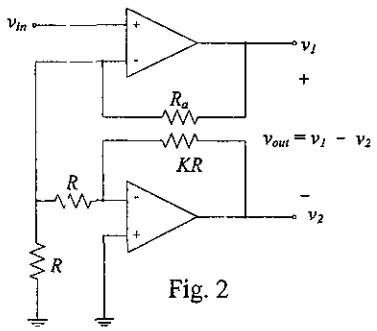

Fig. 2

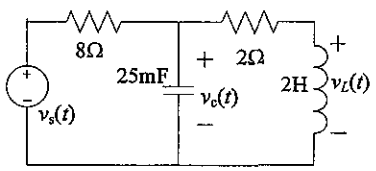

Fig. 3

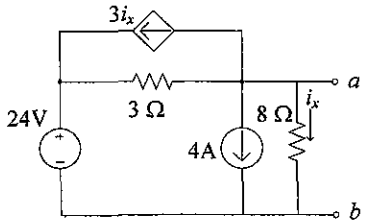

Fig. 4

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