國立臺灣大學 103 學年度碩士班招生考試試題

1. You have designed the circuit as shown in Fig. 1. Given

$$v_s(t) = 10\text{ V} \quad t<0$$
$$= 20\text{ V} \quad t>0$$

(a) (10%) Draw the s-domain equivalent circuit for t > 0.

(b) (10%) Find $V_c(s)$ for t > 0.

(c) (10%) Find $v_c(t)$ for t > 0.

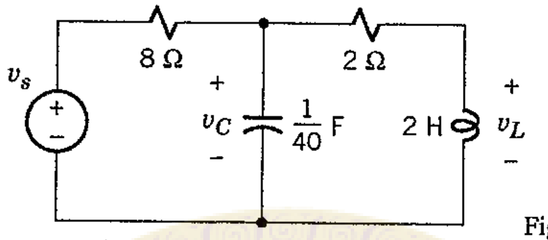

Fig. 1

2. The ladder network in Fig. 2 is a second-order highpass filter when $Z_1 = Z_3 = 1/sC$ and $Z_2 = Z_4 = R$.

(a) (10%) Take $\underline{V}_{out} = 1$ to find $\underline{V}_{in}$ and then obtain $H(s) = \underline{V}_{out}/\underline{V}_{in}$.

(b) (10%) Find ω_{co} in terms of RC with the definition $a^2(\omega_{co}) = 1/2$.

Hint: let $x = R^2C^2\omega_{co}^2$ and solve the quadratic equation of x

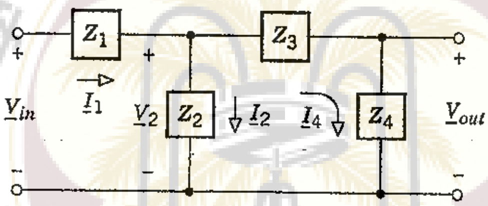

Fig. 2

3. (20%) Use mesh analysis to find the branch currents $i_1(t)$ and $i_2(t)$ in the circuit seen in Fig. 3 if $v(t) = 40\cos(20t)$ V and $i(t) = 4\cos(20t)$ A.

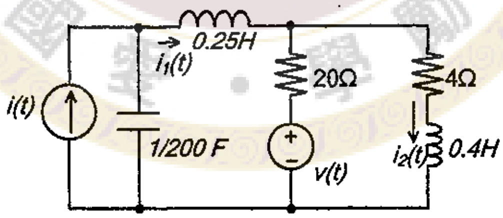

Fig. 3

4. A motor is connected to a 240V(rms), 60Hz source by a transmission line with resistance 1Ω as shown in Fig. 4. The motor has *pf* = 0.5 lagging, and it would draw 4.8kW if operated at 240V(rms). However, the resistance of the transmission line reduces the voltage at the motor and wastes power.

(a) (15%) Find the equivalent impedance of the motor to determine the capacitance *C* that should be connected to terminal AB to minimize the line loss.

(b) (15%) Calculate the resulting values of the rms current and real power from the source and the power-transfer efficiency. Compare these with the values without the capacitor *C*.

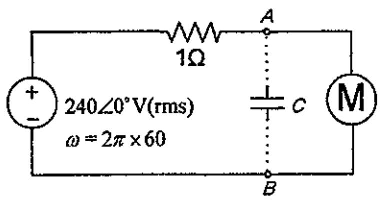

Fig. 4

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