

**Electronic Circuits**  
**Final Examination**  
**10:20am ~ 12:00pm, Jan. 15, 2010**

1. The ladder network in Fig. 1 is a second-order highpass filter when  $Z_1 = Z_3 = \frac{1}{sC}$  and  $Z_2 = Z_4 = R$ .
- (b) [8] Take  $V_{out} = 1$  to find  $V_{in}$  and then obtain  $H(s) = V_{out}/V_{in}$ .
- (c) [7] Find  $\omega_{co}$  in terms of  $RC$  with the definition  $a^2(\omega_{co}) = 1/2$ .  
 (Hint: let  $x = R^2 C^2 \omega_{co}^2$  and solve the quadratic equation of  $x$ .)

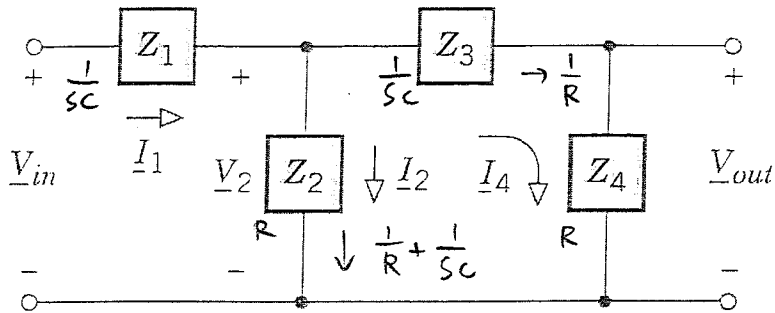


Fig. 1

2. [15] The capacitor in Fig. 2 has been chosen to minimize the current from the 60Hz AC source. Given that the motor has  $pf = 0.4$  and  $|I|_{min} = 10 \text{ A(rms)}$ , find the power and rms current drawn by the motor, and calculate the value of  $C$ .

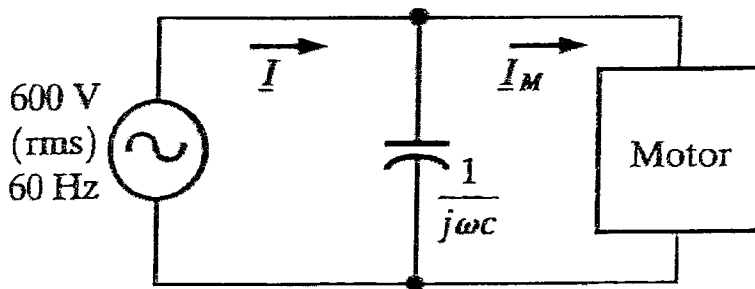


Fig. 2

3. If  $i_c = 3i_1$  and  $v_c = 4v_x$  in Fig. 3.
- (a) [6] write down the matrix mesh equation.
- (b) [6] what are the values of  $v_1, v_2, i_1$ , and  $i_2$ ?

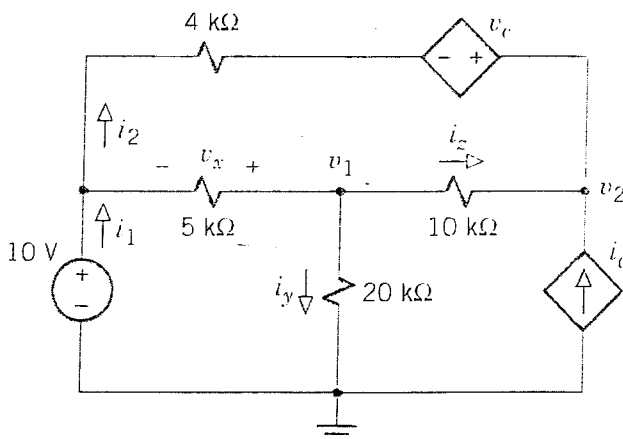


Fig. 3

4. Consider the phase-shift oscillator in Fig. 4.
- (a) [6] Derive the differential equation governing the behavior of  $v_{out}$  with arbitrary value of  $K$ .
- (b) [4] Let  $C = 2\mu\text{F}$ ,  $R = \frac{100}{\sqrt{3}}\Omega$ ,  $L = 10\text{mH}$ . To obtain a sinusoidal output with constant amplitude, what is the value of  $K$ ? What is the oscillation frequency?
- (c) [8] Given that  $v_c(0^-) = 4\text{V}$  and  $i_L(0^-) = 0$ , find  $v_{out}(t)$  for  $t > 0$ .

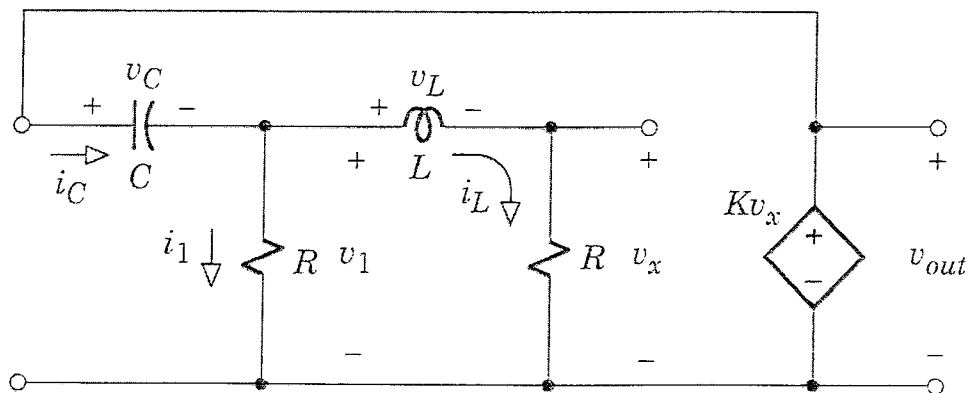
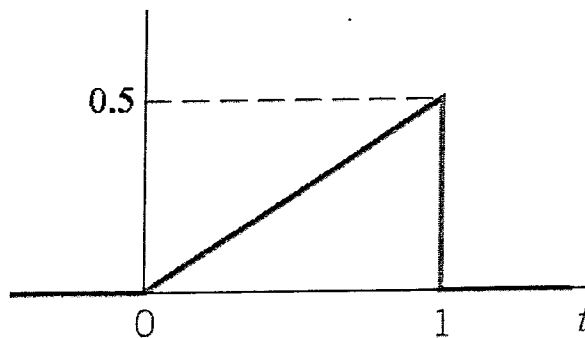


Fig. 4

**NOTE: There are problems in the back.**

5. (a) [10] Calculate the Laplace transform of the function below.  
(b) [10] If this function repeats itself with the period  $T = 5$ , derive the new Laplace transform of the periodic function.



6. [20] In the circuit below, use Laplace transform to find  $v(t)$  and  $i(t)$  given that  $v(0) = 5V$  and  $i(0) = -1A$ .

