Homework 8

Due date:
Jun.9th, 2021
Turn in your homework in class

Rules:

- Please work on your own. Discussion is permissible, but extremely similar submissions will be judged as plagiarism!
- Please show all intermediate steps: a correct solution without an explanation will get zero credit.
- Please submit on time. No late submission will be accepted.
- Please prepare your submission in English only. No Chinese submission will be accepted.

1. [10%] Find the transfer function of $\mathbf{V_o/V_i}$ the filter and determine the type of the filter in Fig.1 and Fig.2

(a).

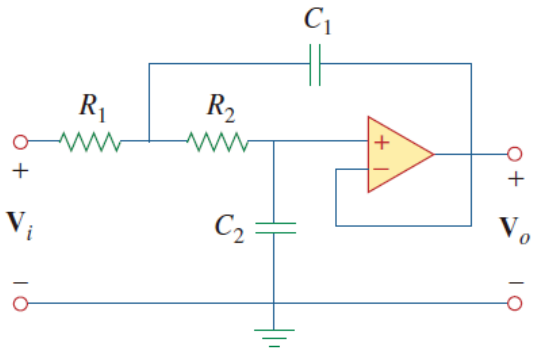

Fig.1

(b).

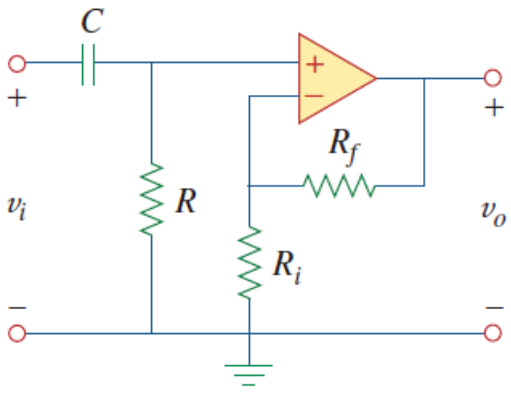

Fig.2

2. [8%] Determine the Laplace transform of these functions
   (a). $f(t) = 3\cos(4t - 1)\,u(t)$
   (b). $g(t) = \cos(2t)\,u(t - \tau)$
   (c). $p(t) = t\cos t\,u(t)$
   (d). $q(t) = \frac{\sin(2t)}{t}u(t)$

3. [8%] Determine the inverse Laplace transform of the following functions

(a). $H(s) = \frac{s^2+4s+5}{(s+3)(s^2+2s+2)}$

(b). $G(s) = \frac{se^{\pi s}}{s^2+1}$

(d). $Y(s) = \frac{5}{s(s+1)(s^2+6s+10)}$

(e). $Z(s) = \frac{2}{s(s+1)^2}$

4. [8%] Use Laplace transform to solve the following integrodifferential equations.

$\frac{d^2v(t)}{dt^2} + 2\frac{dv(t)}{dt} + 10v(t) = 3\cos\ 2t$, with $v(0) = 1, \frac{dv(0)}{d(t)} = -2$.

5. [10%] Let $F(s) = \frac{3(s+3)}{(s+4)(s+1)}$

(a). Use the initial and final value theorems to find $f(0)$ and $f(\infty)$

(b). Verify your answer in part (a) by finding $f(t)$, using partial fractions.

6. [14%] As Fig.3 shows, the switch has been open for a long time. $v_c(0\_) = 5V$. At $t = 0$, the switch is closed. Use Laplace domain method to find $v_c(t)(t > 0)$

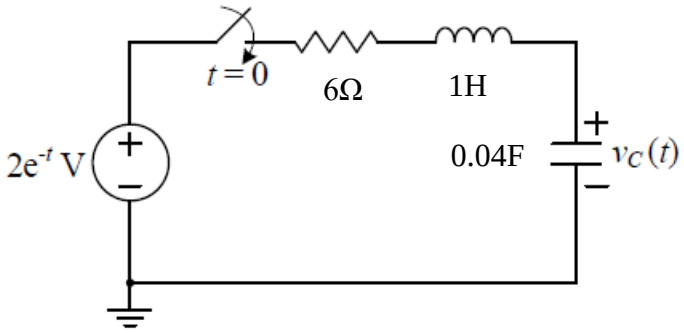

Fig. 3

7. [14%] Synthesize the transfer function

$$\frac{V_o(s)}{V_{in}(s)} = \frac{10^5}{s^2 + 20s + 10^5}$$

Using the topology of Fig. 4, Let $Y_1 = 1/R_1, Y_2 = 1/R_2, Y_3 = sC_1, Y_4 = sC_2$, Choose $R_1 = R_2 = 500\Omega$ and determine C_1, C_2

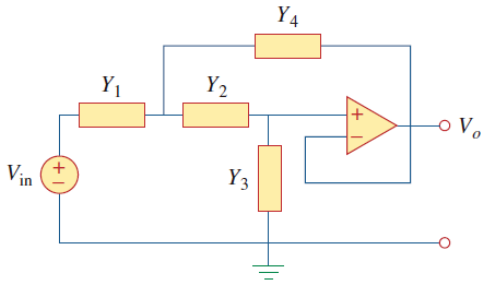

Fig. 4

8. [14%] For the ideal transformer circuit in Fig. 5, if $V_c(0^+) = 2V$, determine $i_o(t)$ using Laplace transform method.

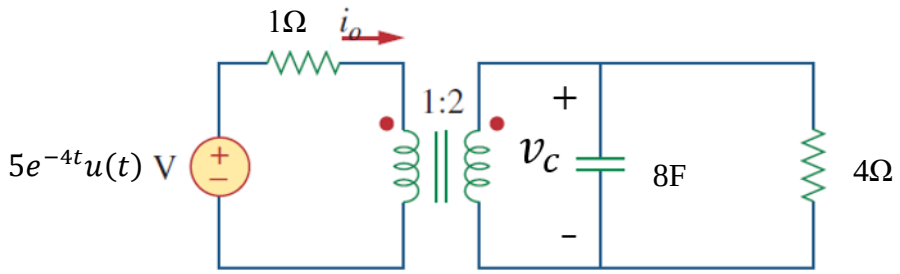

Fig. 5

9. [14%] Given the ideal op amp circuit in Fig. 6, if $v_1(0^+) = 2V$ and $v_2(0^+) = 0V$, use Laplace transform method to find v_0 for $0 < t < 1s$. Let $R = 50k\Omega$ and $C = 2mF$.

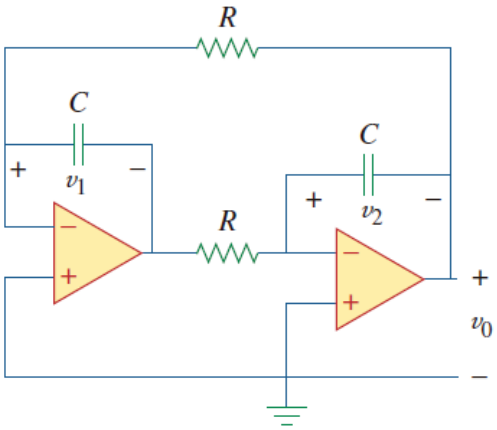

Fig. 6