2001년 1학기 계측회로 II

기말고사 해답

(1)

ⓐ $K = 1 + \frac{R_4}{R_3}$

$$V_o = K \frac{1}{1 + sR_2C_2} V_i$$

$$\frac{V_i - V_1}{R_1} + \frac{V_o/K - V_1}{R_2} + \frac{V_o - V_1}{1/sC_1} = 0$$

$$\therefore H(s) = \frac{V_o}{V_i} = \frac{K}{R_1C_1R_2C_2s^2 + [(1-K)R_1C_1 + R_1C_2 + R_2C_2]s + 1}$$

ⓑ $\omega_o = \frac{1}{RC}$, $Q = \frac{1}{3-K}$

$$RC = \frac{1}{2\pi f_o} = \frac{1}{2\pi \times 30} = 5.3 \times 10^{-3}$$

$C = C_1 = C_2 = 0.1\,\mu F$

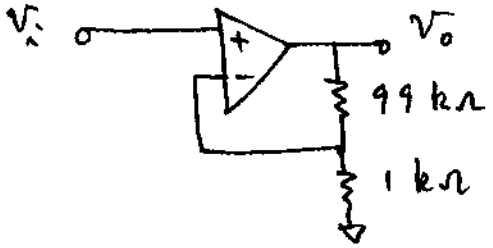
$R = R_1 = R_2 = 53\,k\Omega$

$$K = 3 - \frac{1}{Q} = 3 - \frac{1}{0.707} = 1.586 = 1 + \frac{R_4}{R_3}$$

$R_3 = 10\,k\Omega$, $R_4 = 5.86\,k\Omega$

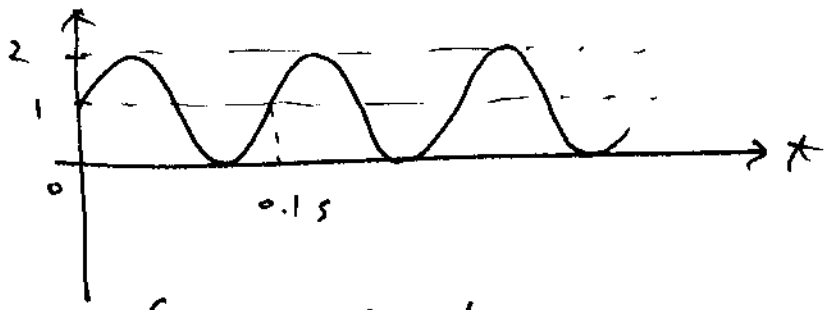
ⓒ $H_{op} = K = 1.586$

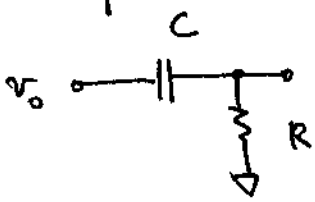
(2)

ⓐ 

ⓑ $v_i = 10 \sin(2\pi \times 100 t)$ mV

$v_o = \sin(2\pi \times 100 t) + 1$ V



ⓒ 

(Hpf, 차단 주파수는 신호 주파수의 $\frac{1}{10}$ 로 선택)

$$\frac{1}{2\pi RC} = 10, \quad RC = \frac{1}{2\pi \times 10} = 1.59 \times 10^{-2}$$

$C = 0.1\,\mu F$, $R = 159\ k\Omega$

ⓓ 위 Hpf의 전달함수 $H'(jw)$

$$H'(jw) = \frac{R}{R + \frac{1}{jwC}} = \frac{jwRC}{1 + jwRC}$$

신호 주파수 $f_s = 100$ Hz 에서

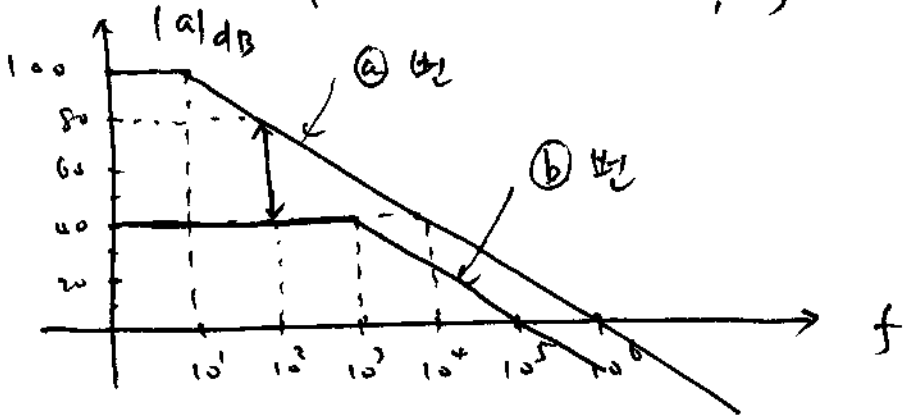
$$H'(j2\pi \times 100) = \frac{j9.9}{1 + j9.9} = 0.9949 \angle 5.77^\circ$$

신호 감쇄 $= 20 \log 0.9949 = -0.044$ dB

위상지연 $= 5.77^\circ$

(3)

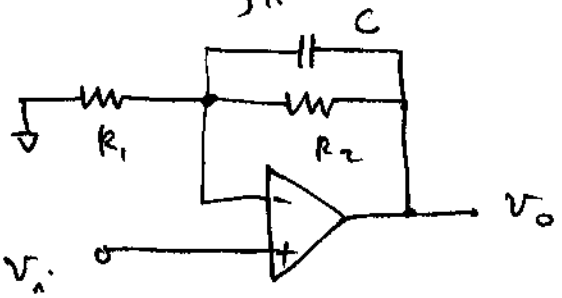
ⓐ $GBP = 10^6$, $a_0 = 100\,dB$, $f_a = 10\,Hz$



ⓑ

$A_v = 100$ 이면 $BW = \frac{10^6}{10^2} = 10^4\,Hz$

따라서 $f_A = 10^3\,Hz$ 로 CH 해야 함.



$R_1 = 1\,k\Omega$, $R_2 = 99\,k\Omega$

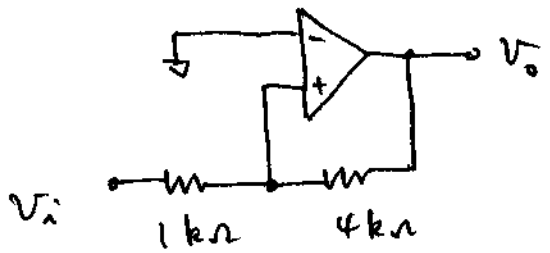
$\frac{1}{2\pi R_2 C} = 10^3$ 이면 $C = 1.6\,nf$

$f = 100\,Hz$ 이면 loop gain $= 40\,dB$

ⓒ $A_v = 1000$ 이면

CH $f_A = \frac{10^6}{10^3} = 10^3\,Hz$

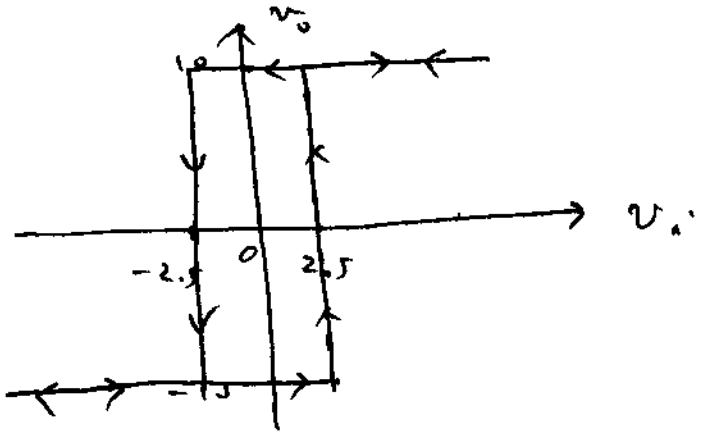
(4)



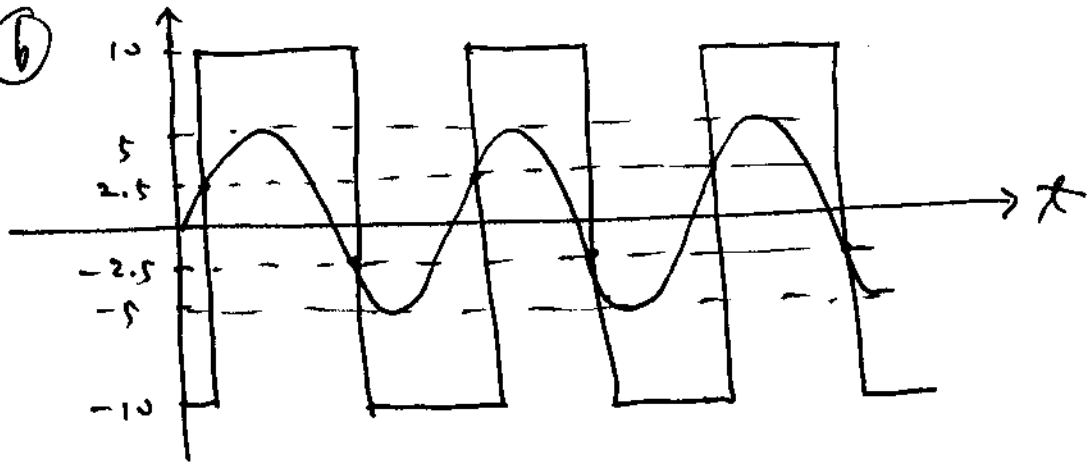
$V_{sat} = \pm 10\,V$

(a) $V_{TH} = \frac{1}{4} \times 10 = 2.5\ V$

$V_{TL} = -\frac{1}{4} \times 10 = -2.5\ V$

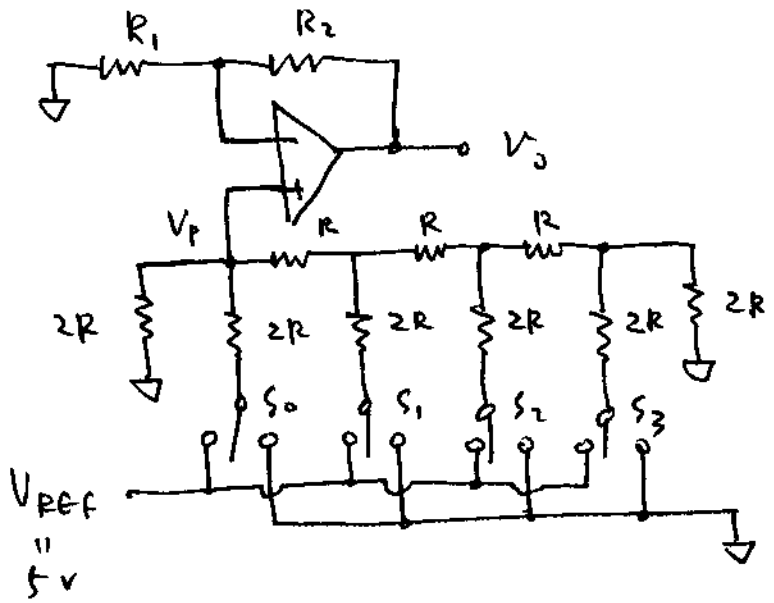


(b)



(나)

ⓐ



(i) S_0 ON (V_{REF}), $V_p = \frac{1}{3} V_{REF}$

(ii) S_1 ON, $V_p = \frac{1}{2} \times \frac{1}{3} V_{REF}$

(iii) S_2 ON, $V_p = \frac{1}{2^2} \times \frac{1}{3} V_{REF}$

(iv) S_3 ON, $V_p = \frac{1}{2^3} \times \frac{1}{3} V_{REF}$

$$V_{FSV} = (1 - 2^{-4}) \times V_{FSR} = 9.375\ V$$

S_2, S_1, S_0 ON 일 때 $V_p = \left(1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8}\right) \times \frac{1}{3} \times 5$

$$= 3.125\ V$$

$$V_o = \left(1 + \frac{R_2}{R_1}\right) V_p = 9.375\ V$$

예시 $R_1 = 1\ k\Omega$, $R_2 = 2\ k\Omega$

ⓑ 8 bit ADC, 0 – 10 V 범위

$V_i = 3.526\ V$

출력 : $b_7\ b_6\ b_5\ b_4\ b_3\ b_2\ b_1\ b_0$

$V_i < 5\ V \Rightarrow b_7 = 0$

$V_i > 2.5\ V \Rightarrow b_6 = 1$

$v_i < 3.75V \Rightarrow b_5 = 0$

$v_i > 3.125V \Rightarrow b_4 = 1$

$v_i > 3.4375 \Rightarrow b_3 = 1$

$v_i < 3.59375 \Rightarrow b_2 = 0$

$v_i > 3.515625 \Rightarrow b_1 = 0$

$v_i < 3.5546875 \Rightarrow b_0 = 0$

$\therefore \quad 01011010$

$$LSB = \frac{10}{2^8} = 0.0391 \quad V$$

$$e_q = \pm \frac{1}{2} LSB = \pm 0.0195 \quad V$$