CENG 2030 HW1 Hung Yu Pan 1155108381

1) $V_{in} = 12V \quad V_{out} = 3V \quad Z_1 = 450k\Omega$

$$V_{out} = V_{in} \times \frac{Z_2}{Z_1 + Z_2}$$

$$3 = 12 \times \frac{Z_2}{450k + Z_2}$$

$$Z_2 = 150 \ k\Omega$$

2) Total capacitor $= C_1 + C_2 + C_3 = 0.6 \ \mu F$

3) $$i(t) = \frac{1}{L} \int_{t_0}^{t} V(\tau) \, d\tau + i(t_0)$$

$$i(t) = 10^6 \int_{t_0}^{t} V(\tau) \, d\tau + 0$$

$$i(t) = 10^6 \int_{0}^{t} 5 \cos(2000t) \, dt$$

$$i(t) = 2500 \sin(2000t)$$

4) $R_{total} = \left[\frac{1}{1000} + \frac{1}{2000} + \frac{1}{3000}\right]^{-1} = \frac{6}{11}\ k\Omega$

$V = 6\ V$ $\qquad V = IR$

$I_{total} = 6 \div \left(\frac{6}{11} \times 1000\right)$

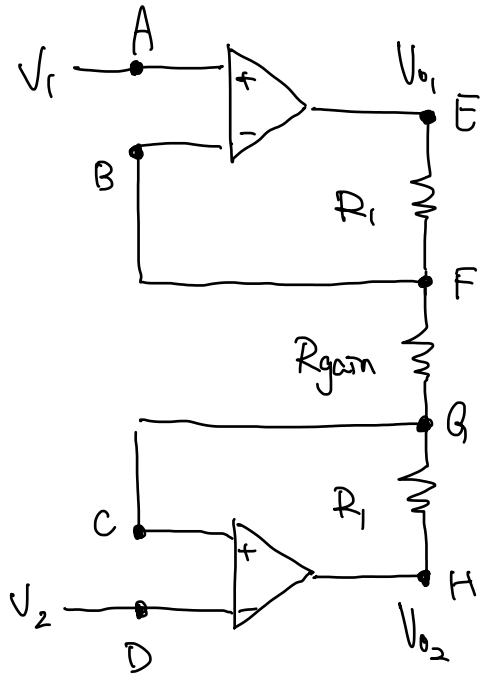
$= 0.011\ A = 11\ mA$ //

$I_{R1} = \frac{V}{R_1} = \frac{6}{1000} = 0.006\ A = 6\ mA$

$I_{R_2} = \frac{V}{R_2} = \frac{6}{3000} = 0.002\ A = 2\ mA$

$I_{R_3} = \frac{V}{R_3} = \frac{6}{2000} = 0.003\ A = 3\ mA$ //

5)



The amplifier in the right-hand side is difference amplifier.

$\therefore V_{out} = \left(\frac{R_3}{R_2}\right)(V_{o_1} - V_{o_2})$ —— (1)

Apply Ohm's law between E and F,

$$I = \frac{V_{o1} - V_{o2}}{R_1 + R_{gain} + R_1} \quad \text{——} \quad (2)$$

The current between G and H,

$$I = \frac{V_G - V_H}{R_{gain}} = \frac{V_1 - V_2}{R_{gain}} \quad \text{——} \quad (3)$$

Combining (2) and (3),

$$V_{o_1} - V_{o_2} = \frac{(2R_1 + R_{gain})(V_1 - V_2)}{R_{gain}} \quad \text{——} \quad (4)$$

From ①, $V_{out} = \frac{R_3}{R_2}(V_{O1} - V_{O2})$

$\therefore V_{O1} - V_{O2} = \frac{R_2}{R_3} V_{out}$ — ⑤

Combining ④, ⑤,

$$V_{O1} - V_{O2} = \frac{R_2}{R_3} V_{out} = \frac{(2R_1 + R_{gain})(V_1 - V_2)}{R_{gain}}$$

$$A_V = \frac{V_{out}}{V_1 - V_2} = \left(1 + \frac{2R}{R_{gain}}\right)\frac{R_3}{R_2} //$$

6) Voltage gain $= -\frac{R_2}{R_1} = -50$ //

$$f_{c1} = \frac{1}{2\pi R_1 C_1} = \frac{1}{2\pi (10^{-7})(1.6)(1000)} = \frac{312.5}{\pi} = 99.5\ Hz$$

$$f_{c2} = \frac{1}{2\pi R_2 C_2} = \frac{1}{2\pi (10^{-9})(80)(1000)} = \frac{6250}{\pi} = 1989\ Hz$$

7) No. 100 Hz is out of the range of f_{c1} to f_{c2} //