BEC
Set-G

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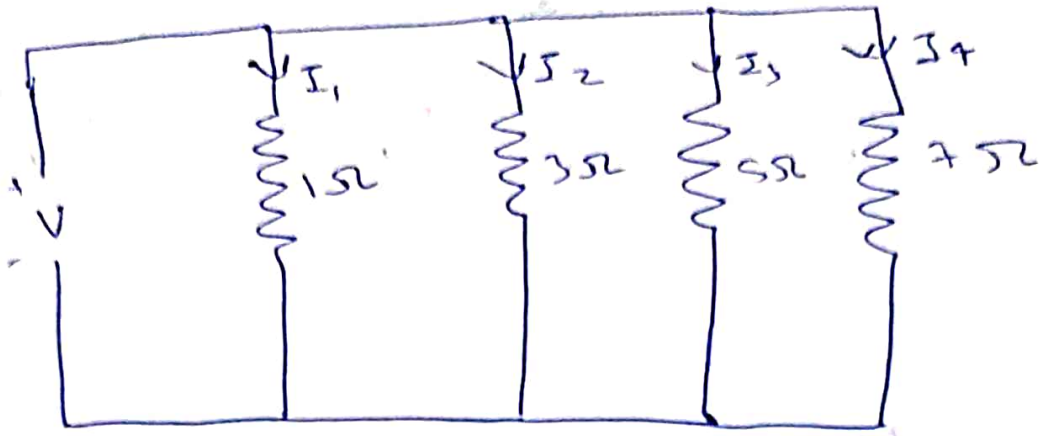
Q-1



$I_1 + I_2 + I_3 + I_4 = I = 28A$

$\frac{1}{R_{eq}} = \frac{1}{1} + \frac{1}{3} + \frac{1}{5} + \frac{1}{7}$

$\frac{1}{R_{eq}} = \frac{105 + 35 + 21 + 15}{105}$

$R_{eq} = \frac{105}{176}\ \Omega$

$V = IR_{eq}$

$V = \frac{28 \times 105}{176}$, $\boxed{V = 16.7V}$

$I_1 = \frac{V}{R_1}$, $I_2 = \frac{V}{R_2}$, $I_3 = \frac{V}{R_3}$, $I_4 = \frac{V}{R_4}$

$\boxed{I_1 = 28A}$, $\boxed{I_2 = 9.33A}$, $\boxed{I_3 = 5.6A}$, $\boxed{I_4 = 4A}$

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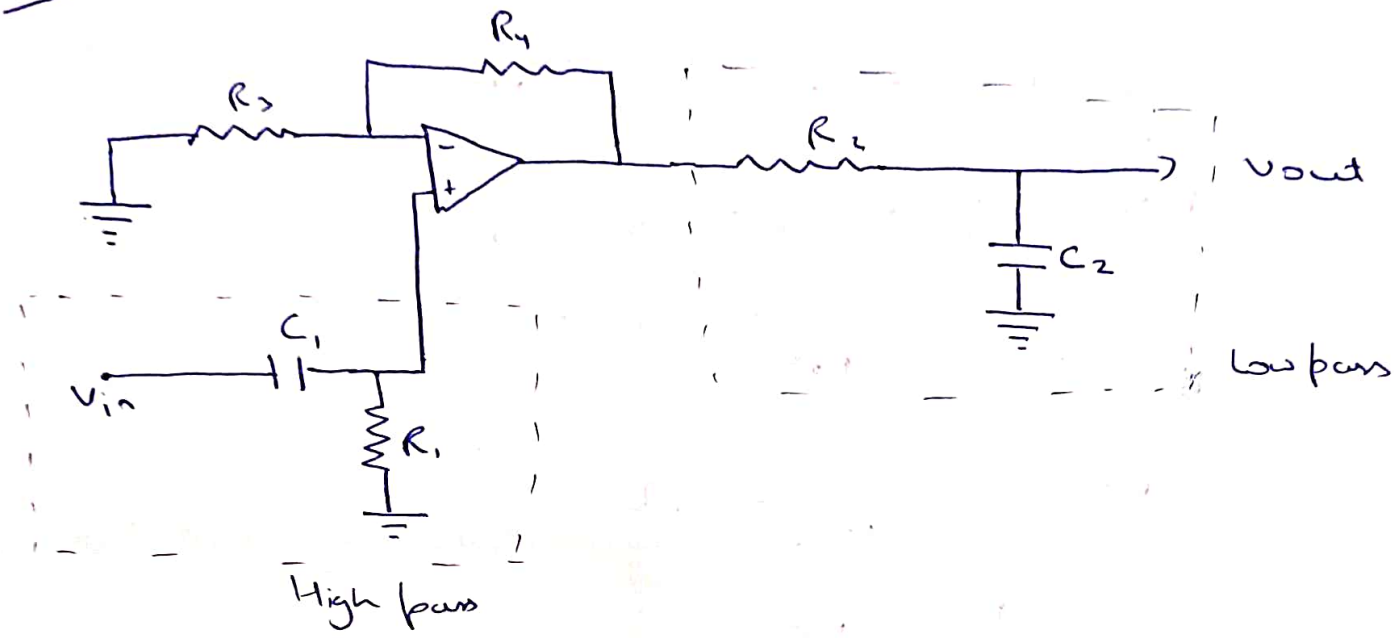
$I_1 = \frac{V}{(R_{eq})_1}$, $I_2 = \frac{V}{(R_{eq})_2}$, $I_3 = \frac{V}{(R_{eq})_3}$, $I_4 = \frac{V}{R_4}$

$I_1 = 167\ mA$, $I_2 = 5.56\ A$, $I_3 = 3.39\ A$, $I_4 = 2.38\ A$

Q2



Gain of High pass = $\frac{\left(1+\frac{R_4}{R_3}\right)\frac{f}{f_c}}{\sqrt{1+\left(\frac{f}{f_c}\right)^2}}$

where $f_c = \frac{1}{2\pi R_2 C_2}$

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~~$V_{out} = V_H V_L$~~ ~~$V_L = V_H V_{in}$~~

$$V_H = \frac{R_1}{\sqrt{R_1^2 + X_C^2}} V_{in} \qquad V_{ref} = V_H$$

$$= \frac{R_1}{\sqrt{R_1^2 + \frac{R_1^2}{4\pi^2 f^2 R_1^2 C_1^2}}} V_{in}$$

$$= \frac{1}{\sqrt{1 + \left(\frac{f_L}{f}\right)^2}} V_{in}$$

$$= \frac{\left(\frac{f}{f_L}\right)^2}{\sqrt{1 + \left(\frac{f}{f_L}\right)^2}} V_{in}$$

$$V_O = \frac{X_C}{\sqrt{R_2^2 + X_C^2}} V_{ref}$$

$$= \frac{1/\omega C_2}{\sqrt{R_2^2 + \frac{R_2^2}{4\pi f^2 R_2^2 C_2^2}}} V_{ref}$$

$$= \frac{f_H/f}{\sqrt{1 + (f_H/f)^2}} V_{ref}$$

$$V_{out} = \frac{\left(1 + \frac{R_4}{R_3}\right)\frac{f}{f_L}}{\sqrt{1 + \left(\frac{f}{f_L}\right)^2}} \frac{1}{\sqrt{1 + \left(\frac{f}{f_H}\right)^2}}$$

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$A_{cl} = 10$

$\left(1 + \frac{R_f}{R_3}\right) = 10$

$f = f_r = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$

$= \frac{1}{2\pi\sqrt{3 \times 3 \times 0.8 \times 0.006 \times 10^{-6} \times 10^{-6} \times 10^{-6}}}$

$f_H = \frac{1}{2\pi R_2 C_2} = \frac{1}{2\pi \times 3 \times 0.006 \times 10^{3} \times 10^{-6}}$

$f_L = \frac{1}{2\pi R_1 C_1} = \frac{1}{2\pi \times 3 \times 0.8 \times 10^{3} \times 10^{-6}}$

$f_0 \simeq 77$, $f_H = 8842$, $f_L = 66.3$

$V_{out} = \frac{10 \times \frac{77}{66.3} \times 12}{\sqrt{1 + \left(\frac{77}{8842}\right)^2}\sqrt{1 + \left(\frac{77}{66.3}\right)^2}}$

~~$V_{out} \simeq 8.66$~~ $V_{out} \simeq 104$

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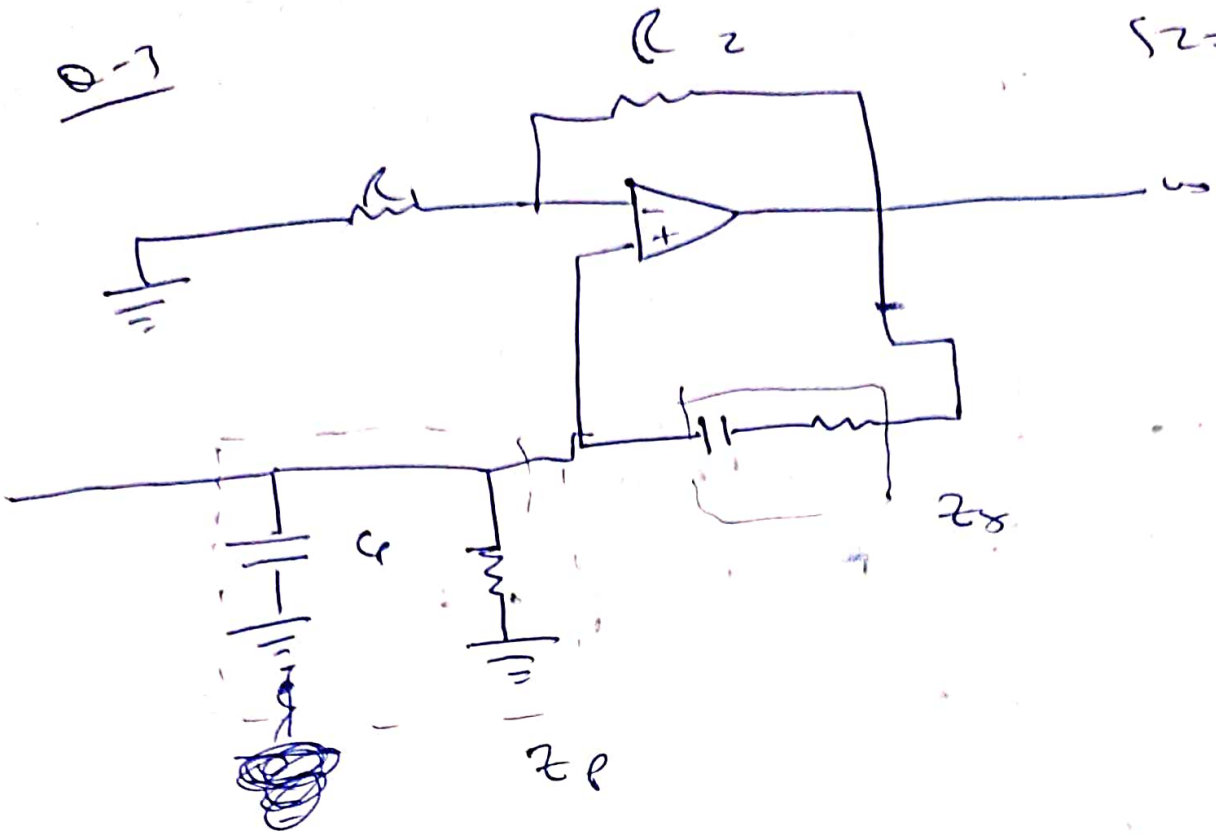
Q-3



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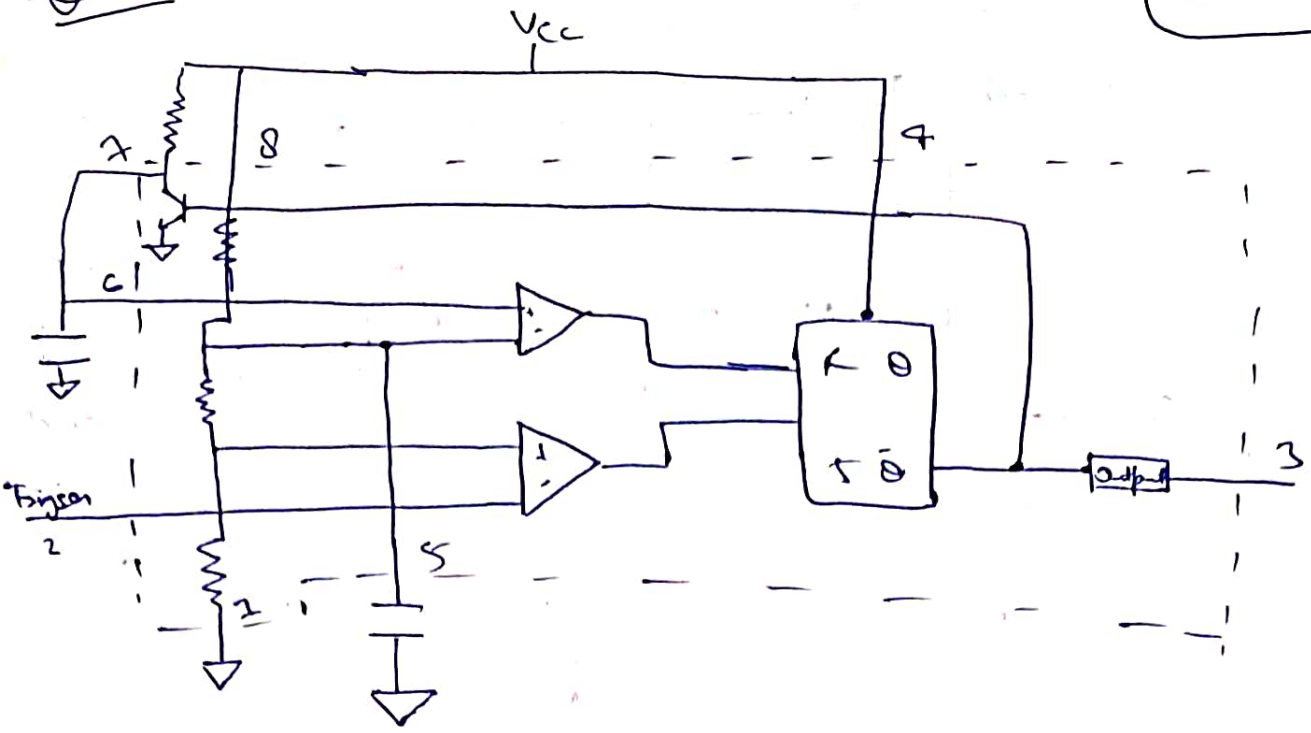
Q-4



Intended Circuit

Voltage across capacitor

$$V_c = V_f + (V_i - V_f)\, e^{-t/R_1 C_1}$$

$V_f = +V_{cc}$, $V_i = 0V$,

the capacitor will charge upto

$$V_c = 2/3\, V_{cc}$$

$$\frac{2}{3} V_{cc} = V_{cc} - V_{cc} e^{-t/R_1 C_1}$$

$$\frac{2}{3} = 1 - e^{-t/R_1 C_1}$$

$$-t/R_1 C_1 = \ln 1/3$$

$$\boxed{t = 1.1 R_1 C_1}$$

$$f = \frac{1}{1.1 \times 10 \times 1.2 \times 10^3 \times 10^{-9}} = \frac{10^7}{12 \times 11} \text{ Hz}$$

Q.5

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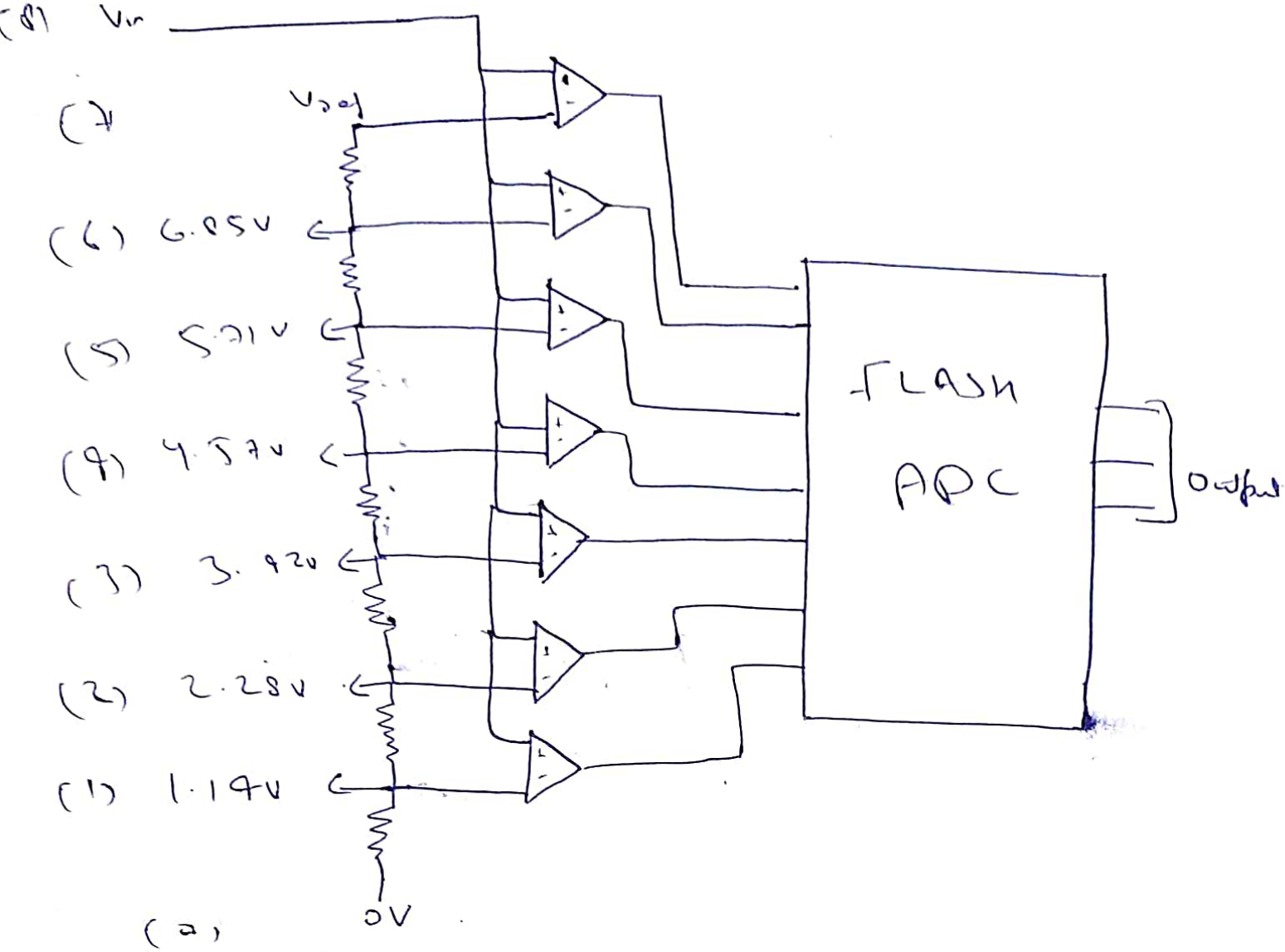

(a)

$$V_D = \frac{8}{7R} \times R_{eq}$$

Voltage at input 6 is greater than input voltage, hence we will get binary output of code 5.

i.e 101

Binary output = 101