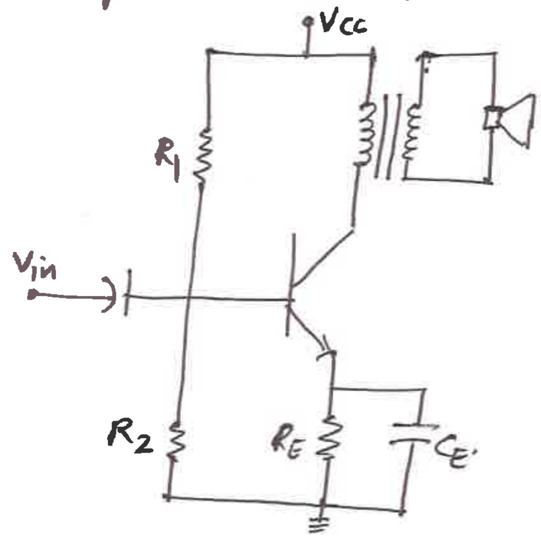
Solution of Linear Integrated Circuits

S.E. - Sem-IV - (CBCGS) - Biomedical Engineering.

Subject Code - 40103 57409

Q. No.		Marks

Q-2 (a) Class A transformer coupled power amplifier to $8\,\Omega$ load -.



$P_L = 10W$, $R_L = 8\,\Omega$

Assume $\eta_T = 0.9$

$\therefore \quad P_L' = \dfrac{P_L}{\eta_T}$

$P_{d(max)} \geq 2 P_L'$

Select Vcc $\left(V_{CC} \leq \dfrac{V_{CEO}}{2}\right)$

$V_{RE} = 10\,\%\; V_{CC}$

$R_L' = \dfrac{V_{CC} - V_{RE} - V_{CE(sat)}}{2 P_L'}$

$\dfrac{N_1}{N_2} = \sqrt{\dfrac{R_L'}{R_L}}$

$S \leq 10 = \dfrac{(1+\beta_{max})(1+k)}{1+\beta_{max}+k}$

$k = \dfrac{R_{th}}{R_E}$

Solution of. Linear Integrated Circuit.
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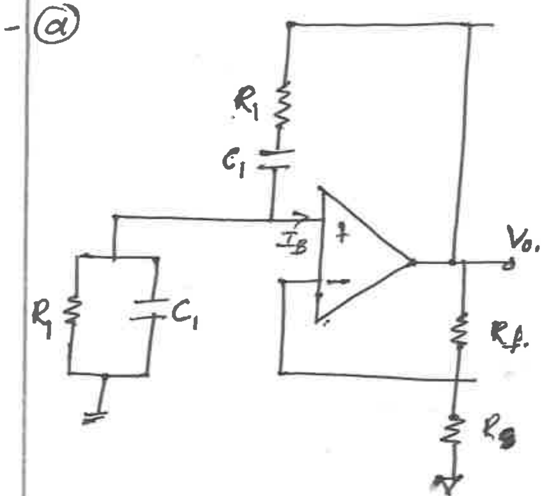
Duration .... Hours. Total Marks assigned to the paper ....

Q. No.		Marks

N.B.: Any other valid design approach can also be considered while assessment.

Q-3-(a)



$f = 10 KHz$. - Wein Bridge Osc^n.

$R_f = 2R_1$

$f = \frac{1}{2\pi RC}$

$I_i = I_f + I_B$ & $I_{B(max)} = 100 \times 500\,nA = 50\,\mu A$.

Let $V_{cc} = 15V \Rightarrow V_0 = V_{cc} - 1 = 14V$.

$A_V = \frac{V_o}{V_{in}} \Rightarrow$ gain $= \frac{R_f}{R_1} = 2$.

$\therefore V_{in} = \frac{V_o}{A_V} = \frac{14}{2} = 7$.

$R_1 = \frac{V_{in}}{I_i} = \frac{7V}{50\mu A} = 0.14\,M\Omega = 140k\Omega$

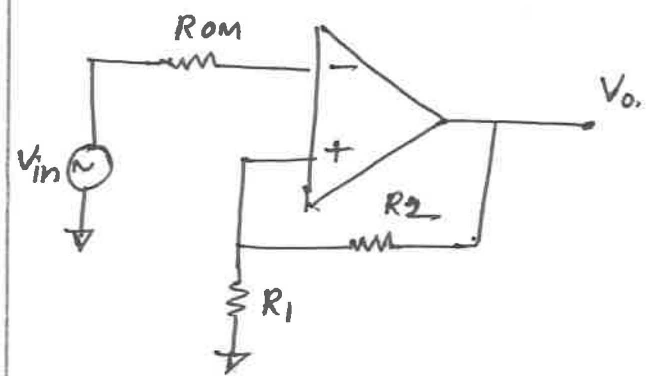
$R_f = 2R_1 = 2 \times 140k = 280k$.

$R = \frac{R_1}{10} = \frac{140}{10} = 14k \simeq 15k$ (Std)

$C = \frac{1}{2\pi f \cdot R} = 0.001\mu F$.

Q. No. | Marks

Q-3-(b) $V_{ut} = 4V$, $V_{lt} = -4V$ $\quad V_{cc} = V_{EE} = \pm 15V$.



$$V_{ut} = \frac{R_1}{R_1 + R_2}(+V_{sat})$$

$$V_{lt} = \frac{R_1}{R_1 + R_2}(-V_{sat})$$

$$V_{hy} = V_{ut} - V_{lt}$$

As $|V_{cc}| = |V_{EE}| = 15V$, V_{sat} & $-V_{sat} = \pm 14V$

$$V_{ut} = \frac{R_1}{R_1 + R_2} \times 14V.$$

Let $R_1 + R_2 = 10K$

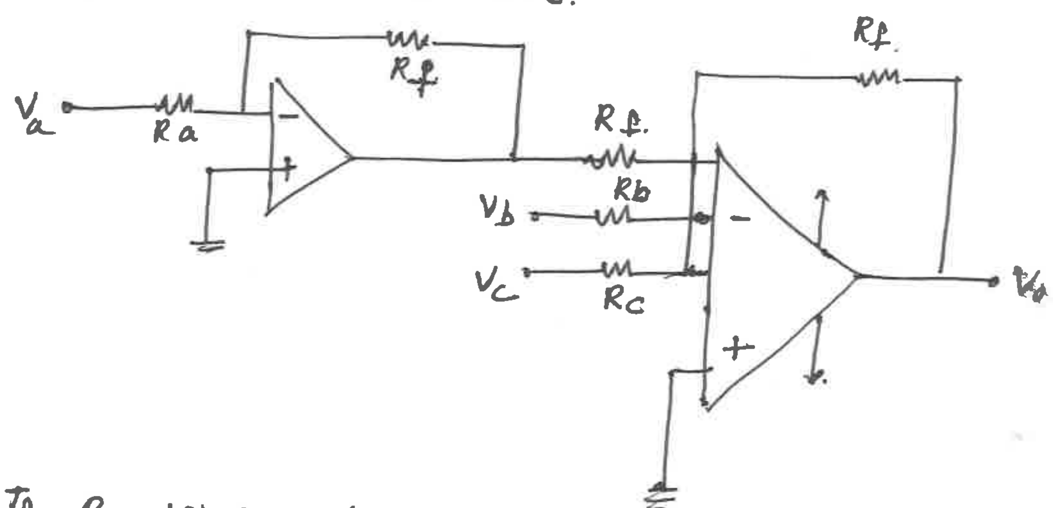
$$\therefore R_1 = V_{ut} \times \frac{R_1 + R_2}{14}$$

$$= 4 \times \frac{10}{14}$$

$$= 2.85K.$$

$$\therefore R_2 = 7.15K.$$

(c) $V_o = 3V_a - 5V_b - 6V_c$.



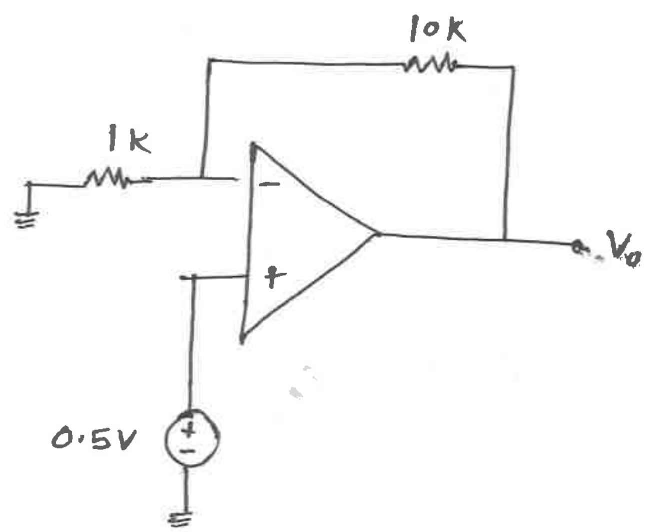
If $R_f = 10k\Omega$, $R_a = 3.33k$, $R_b = 2k$, $R_c = 1.67K$.

Q. No. | Marks

$V_{oa} = -V_a \cdot \frac{R_f}{R_a}$

$V_o = -\left(V_{oa} \frac{R_f}{R_f}\right) - V_b \cdot \frac{R_f}{R_b} - V_c \cdot \frac{R_f}{R_c}.$

(d)



$I_L = \frac{V_0 - V_1}{R_L}$

$V_1 = 0.5V$ by Virtual short.

$V_o = \left(1 + \frac{R_f}{R_1}\right) \cdot V_1$

$= \left(1 + \frac{10}{1}\right) V_1$

$= 5.5V.$

$\therefore I_L = \frac{5.5 - 0.5}{10} = 0.5mA$

If $R_L = 20k$ $I_L = \frac{10.5 - 0.5}{20} = 0.5mA.$

Q. No. | Marks

Q-5 (a) D.C analysis -

$$I_E = \frac{V_{EE} - V_{BE}}{\frac{R_{in}}{\beta} + 2R_E} \quad \text{or} \quad \frac{V_{EE}}{2R_E}$$

$$V_{CE} = (V_{CC} - I_C R_C) - (-V_{BE}) = V_{CC} + V_{BE} - I_C R_C$$
$$= -11.79$$

a c analysis -

$$r_e = \frac{26\,mV}{I_{CQ}} = 2.7\,\Omega$$

$$A_d = \frac{R_C}{r_e} = 1.2k.$$

$$A_c = \frac{-R_C}{r_e + 2R_E} = \frac{3.3}{2.7\,\Omega + 2\times 1k}$$
$$= 1.65$$

$$R_{id} = 2\beta_{ac} \cdot r_e$$
$$= 2 \times 100 \times 2.7\,\Omega$$
$$= 540\,\Omega.$$

$$CMRR = \frac{r_e + 2R_E}{r_e} \text{ or } \frac{A_d}{A_c}$$
$$\approx 740.$$

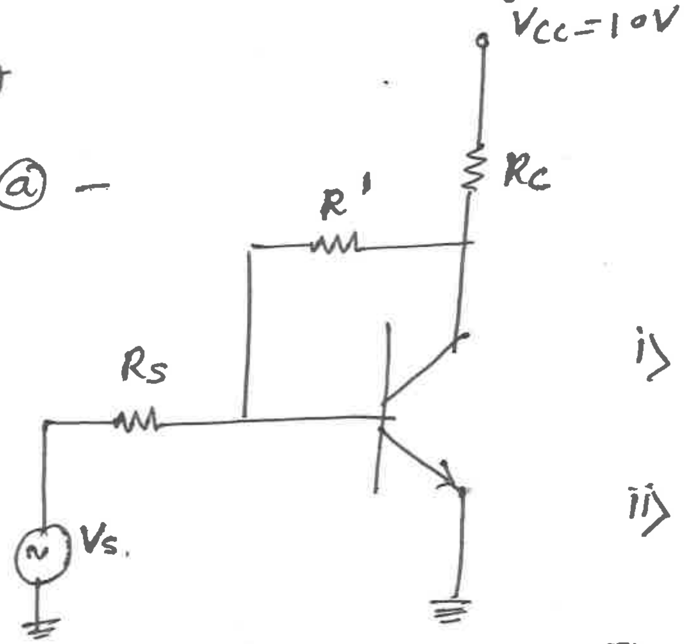
$$R_o = R_C = 3.3k.$$

Q. No. | Marks

~~Q-3 (a) Design a wein bridge oscillator for 10 KHz frequency.~~

~~(b)~~

Q-6- (a) —



Type of feedback –
Shunt Shunt f/b.

i) $\beta = \frac{-I_f}{V_o}$

ii) $R_M = \frac{V_o}{I_s}$

iii) $D = 1 + \beta \cdot R_M$

iv) $A_{vf} = \frac{R_{MF}}{R_S}$

v) $R_{if} = \frac{R_i}{D}$.

vi) $R_{of} = \frac{R_f \parallel R_C}{D}$.