Assignment -2

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Problem : 1 - Design an amplifier using your assigned BJT.

Solve:

Here, The last 3 digit of my ID is : 174

Sum of the 3 digit is : $(1+7+4) = 12$ (even)

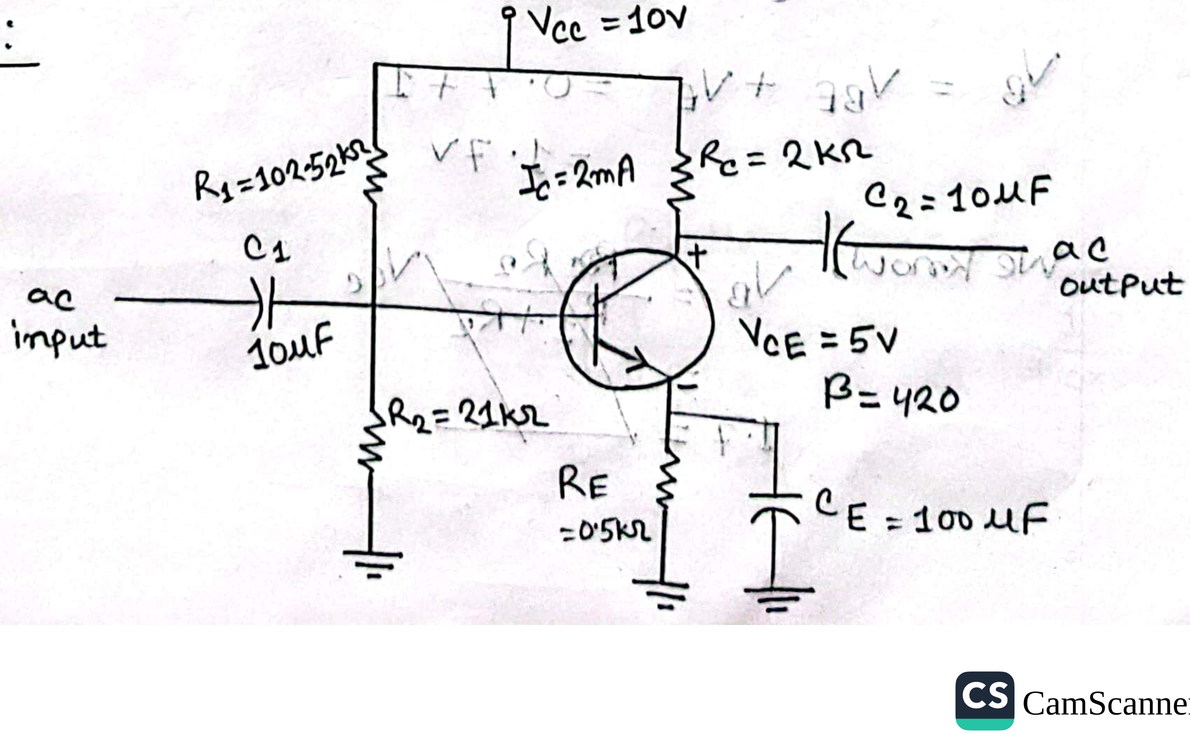
so, the BJT is : BC547C

From datasheet, $I_C = 2\ mA$, $V_{CE} = 5.0V$

$\therefore V_{CC} = 2V_{CE} = (2\times5) = 10V$

$\beta = 420$

Circuit :



We know, $V_E = \frac{1}{10} V_{cc} = \frac{1}{10} \times 10 = 1V$

Now, $I_E = \frac{V_E}{R_E}$

$\therefore R_E = \frac{V_E}{I_E}$

$\Rightarrow R_E = \frac{V_E}{I_C} \quad [\because I_E \cong I_C]$

$= \frac{1}{2 \times 10^{-3}}$

$= 500\Omega = 0.5\,k\Omega$

$I_B = \frac{I_C}{\beta} = \frac{2}{420} = 4.76 \times 10^{-3}\,mA$

$V_{RC} = V_{cc} - V_{CE} - V_E = (10 - 5 - 1) = 4V$

$\therefore R_C = \frac{V_{RC}}{I_C} = \frac{4}{2 \times 10^{-3}} = 2000\Omega = 2k\Omega$

$V_B = V_{BE} + V_E = 0.7 + 1$

$= 1.7V$

Now, $\beta R_E \geqslant 10 R_2$

$$\Rightarrow R_2 \leq \frac{1}{10} \beta R_E$$

$$\Rightarrow R_2 \leq \frac{1}{10} \times 420 \times 0.5$$

$$\Rightarrow R_2 \leq 21\,k\Omega \quad \therefore R_2 = 21\,k\Omega$$

We know, $V_B = \frac{R_2 V_{cc}}{R_1 + R_2}$

$$\Rightarrow 1.7 = \frac{21 \times 10}{R_1 + 21}$$

$$\therefore R_1 = 102.52\,k\Omega$$

Here, $r_e = \frac{26\,mV}{I_E}$

$$= \frac{26\,mV}{I_c} \quad [\because I_c \cong I_E]$$

$$= \frac{26\,mV}{2.0\,mA}$$

$$= 13\,\Omega$$

$$= 0.013\,k\Omega$$

Here, input impedance, $Z_{in} = R_1 \parallel R_2 \parallel \beta r_e$

$$= \left(\frac{1}{102.52} + \frac{1}{21} + \frac{1}{420 \times 0.013}\right)^{-1}$$

$$= 4.1575\,k\Omega$$

Output impedence, $Z_{out} = R_C \| r_o$

$$= \left(\frac{1}{R_C} + \frac{1}{r_o}\right)^{-1}$$

$$= \left(\frac{1}{R_C} + \frac{1}{\infty}\right)^{-1} \quad [r_o \approx \infty]$$

$$= \left(\frac{1}{R_C}\right)^{-1} = \left(\frac{1}{2}\right)^{-1}$$

$$= 2 k\Omega$$

Input AC $V = (1+7+4) \div 3 = 4\cancel{0} mV$

Here, $A_V = \frac{V_o}{V_s} = \frac{486.27}{4}$ [Peak value : 486.27 mV]

$$= 121.56$$

Problem 2 : Design a relay module

Solve :

ID is : 174

sum is : $(1+7+4) = 12$ (even)

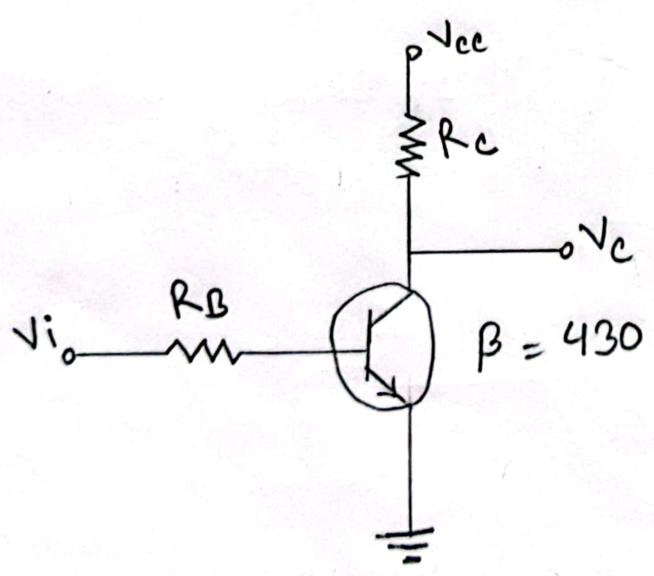
So, I have to ~~degi~~ design 9V relay module.

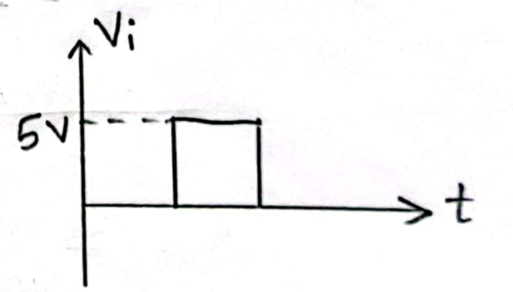
From datasheet of SRD-09VDC-SL-C relay,

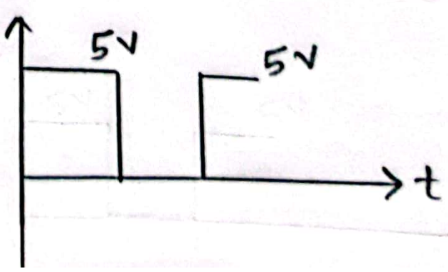
$$I_{C_{sat}} = 50\,mA$$

For BC547C BJT, $\beta = 430$ (400 to 600)

Here, $V_i = 5V$







$$I_B' = \frac{I_{Csat}}{\beta} = \frac{50\times10^{-3}}{430}$$

$$= 116.27\ \mu A$$

$$I_B > I_B'$$

So, $I_B = 232.54\ \mu A$

$$\therefore R_B = \frac{V_i - 0.7}{I_B} = \frac{5-0.7}{232.54\times10^{-6}} = 18.491\ k\Omega$$