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① So, 5+4+8 = 17 (odd), So the BJT is BC548.

collecting data sheet,

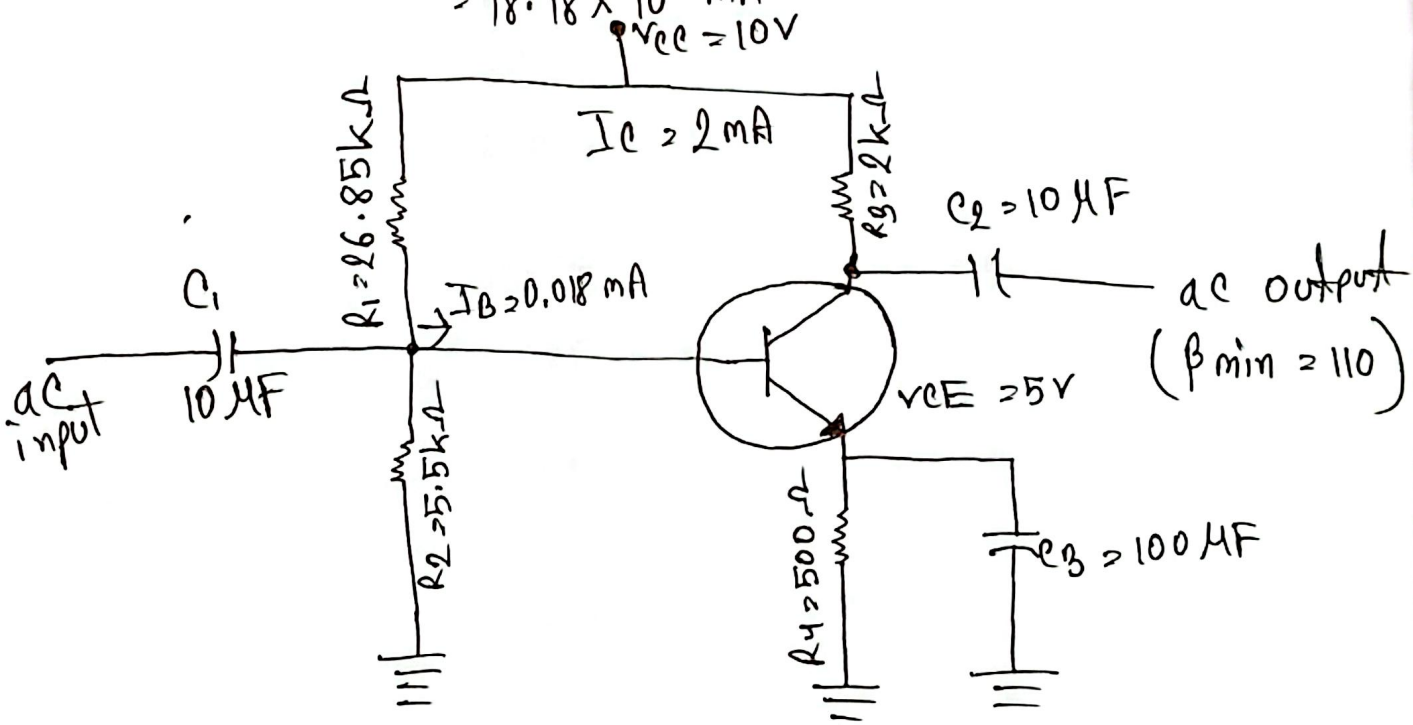
$I_C = 2.0\ mA$, $V_{CE} = 5.0\ V$

$\beta\ (min) = 110$

$V_{CC} = 2V_{CE} = 10V$

$$I_B = \frac{I_C}{\beta} = \frac{2mA}{110} = 0.01818\ mA$$

$$= 18.18 \times 10^{-3}\ mA$$



$$V_E = \frac{1}{10} V_{CC} = \frac{1}{10} \times 10 = 1V$$

$$R_4 = R_E = \frac{V_E}{I_E} = \frac{V_E}{I_C} = \frac{1}{2 \times 10^{-3}} = 500\Omega$$

$V_{RC} = V_{CC} - V_{CE} - V_E = 10 - 5 - 1 = 4V$

$\therefore R_C = \frac{V_{RC}}{I_C} = \frac{4V}{2\times10^{-3}A} = 2000\,\Omega$

$= 2k\Omega$

$V_B = V_{BE} + V_E = 0.7 + 1 = 1.7V$

Now, $V_B = \frac{R_2}{R_1+R_2} V_{CC}$

$\Rightarrow 1.7 = \frac{5.5}{R_1+5.5} \times 10$

$\Rightarrow R_1 = 26.85\ k\Omega$

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

$\Rightarrow R_2 \leq \frac{1}{10} \times 110 \times 500\,\Omega$

$\therefore R_2 \leq 5.5\ k\Omega$

Now, $r_e = \frac{26mV}{I_E} \cong \frac{26mV}{I_C} = \frac{26\,mV}{2mA} = 13\,\Omega$

input impedence, $Z_{in} = R_1 \| R_2 \| \beta r_e$

$= \left(\frac{1}{26.85} + \frac{1}{5.5} + \frac{1}{110\times13\times10^{-3}}\right)^{-1}$

$= 1.088\ k\Omega$

output impedence, $Z_{out} = R_C \| r_o$ $\quad [r_o = \infty]$

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

$= \left(\frac{1}{R_C} + \frac{1}{\infty}\right)^{-1} = R_C = 2k\Omega$

Input AC $V = (5+4+8)/3$

$= 5.67\ mV$

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The sum of the last 3 digit (5+4+8 = 17) (odd)

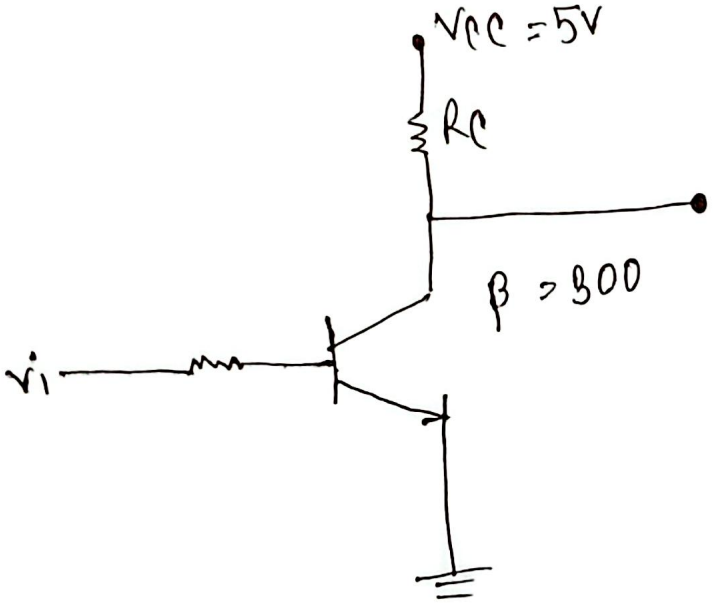
So, I design a 5V relay module circuit.

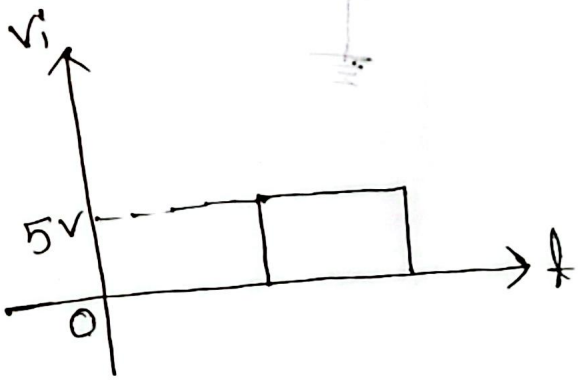
Use, SRD – 05VDC – SL – C

Here, $I_{C\,sat}$ = 89.3 [Datasheet]

using BC548 BJT

for 89.3 mA, β = 300 (110 – 800)

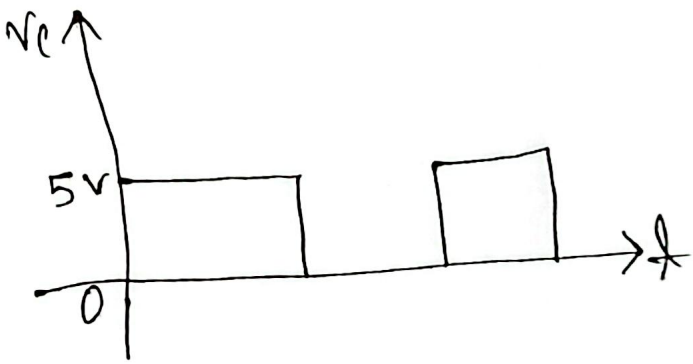




$$I_B > \frac{I_{C\,sat}}{\beta}$$

$$\therefore I_B > \frac{89.3}{300}$$

$$\therefore I_B > 0.2977 \text{ mA}$$



Let,

$I_B = 0.35\ mA$

$\therefore R_B = \frac{V_i - 0.7}{I_B} = \frac{5 - 0.7}{0.35}$

$= 12.285\ k\Omega$