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Problem – 1

Last 3 digit of my ID = 388

$x = 3+8+8 = 19$, which is odd number

So, my BJT is BC548

from the datasheet of BJT BC 548

"On characteristics",

$I_C = 2.0\ mA$

$V_{CE} = 5.0\ V$

$h_{FE} = \beta(min) = 110$

Now, $V_{CC} = 2 \times V_{CE} = 2 \times 5.0 = 10V$

we know,

$I_C = \beta \times I_B$

$\therefore I_B = \frac{I_C}{\beta} = \frac{2\ mA}{110} = \frac{2 \times 10^{-3}}{110} = 18.18\ mA$

and,

$I_E = I_C = 2\ mA$

Here, $V_E = \frac{1}{10} \times V_{cc}$

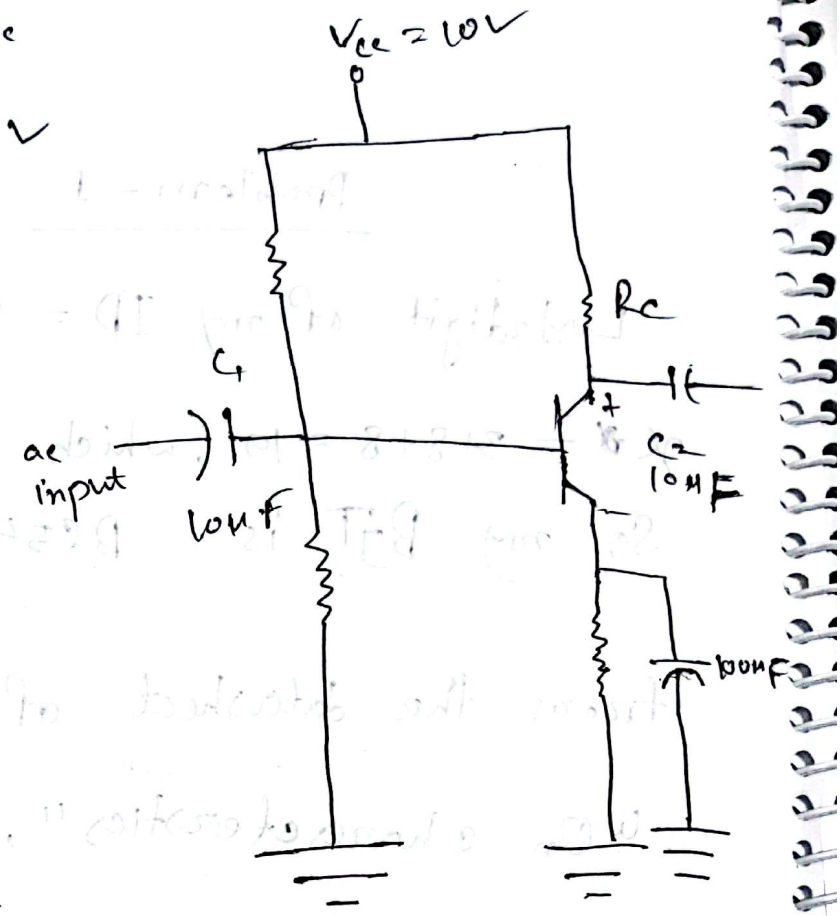
$= \frac{1}{10} \times 10)\ V$

$= 1\ V$

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

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

$= 500\ \Omega$



Now,

$V_{Rc} = V_{cc} - V_{CE} - V_E$

$= (10 - 5 - 1)\ V$

$= 4V$

$R_c = \frac{V_{Rc}}{I_c} = \frac{4}{2 \times 10^{-3}}$

$= 2000\ \Omega$

Now,

$V_{DE} = V_B - V_E$

$\therefore V_B = V_{DE} + V_E$

$= (0.7 + 1)\ V$

$= 1.7\ V$

We know,

$B_{RE} \geq 10 \times R_2$

$\Rightarrow R_2 \leq \frac{B_{RE}}{10}$

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

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

Now,

$V_B = \frac{R_2 \times V_{ecc}}{R_1 + R_2}$

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

$\therefore R_1 = \frac{5.5}{1.7} - 5.5 = 26.85\ k\Omega$

Here, $R_e = \frac{26mV}{I_E} = \frac{26mV}{2 \times 10^{-3}} = 13\Omega$

input impedence,

$Z_{in} = R_1 \parallel R_2 \parallel B_{re}$

$= \left(\frac{1}{26.85 \times 10^3} + \frac{1}{5.5 \times 10^3} + \frac{1}{110 \times 10^3} \right)^{-1}$

$= 1088.89\ \Omega$

Output impedence,

$$Z_{out} = R_e \| r_o$$

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

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

$$= \left(\frac{1}{2} + 0\right)^{-1}$$

$$= 2k\Omega$$

$$= 2000\Omega$$

Now, In the input,

$$Y = \frac{3+8+8}{3} = \frac{19}{3} = 6.33\ mV$$

$f = 1\ kHz$, waveform = Sinusodial

Here, $V_i = Y = 6.33\ mV$

$V_o = 711.67\ mV$

$$\therefore Av = \frac{V_o}{V_i} = \frac{711.67\ mV}{6.33}$$

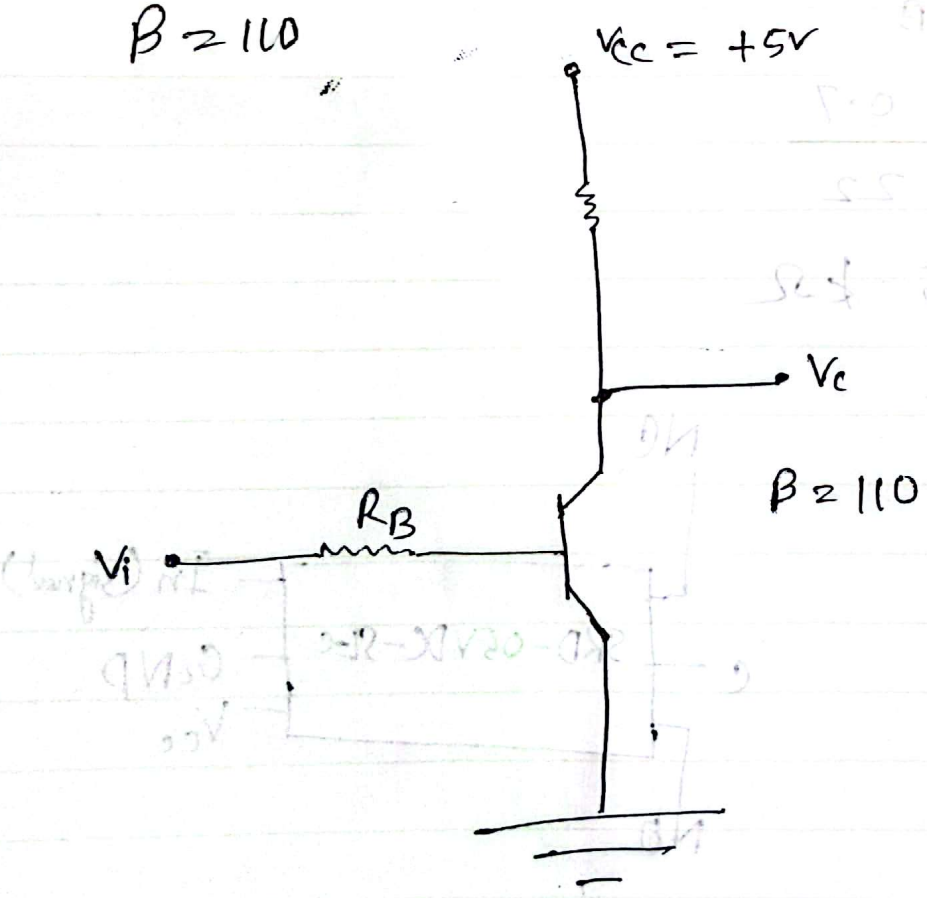
$$= 112.43\ mV$$

Problem-2

As the sum of the last 3 digit of my ID (3+8+8)=19 is odd, I'll design 5V relay module.
And I'll use the SRD-~~09~~05VDC-SL-C relay. ~~shown~~

From datasheet, $I_{c,sat} = 89.3$ mA

Now,
using BC548 BJT because,
Ic collection current (DC)
max = 100 mA
That's why we can use BJT – BC548..



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

$$\Rightarrow I_B > \frac{89.3}{110} \text{ mA}$$

$$\therefore I_B > 0.811 \text{ mA}$$

let, $I_B = 1.622$ mA [Double of $\frac{I_{c\,sat}}{\beta}$]

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

$$= \frac{5 - 0.7}{1.622}$$

$$= 2.65 \text{ k}\Omega$$