Assignment-2

Problem-1

1. Find out BJT, The sum of last 3 digit of student ID = 5+4+1 = 10 (even)

So, the BJT is BC547C

2. From the datasheet of BC547C BJT

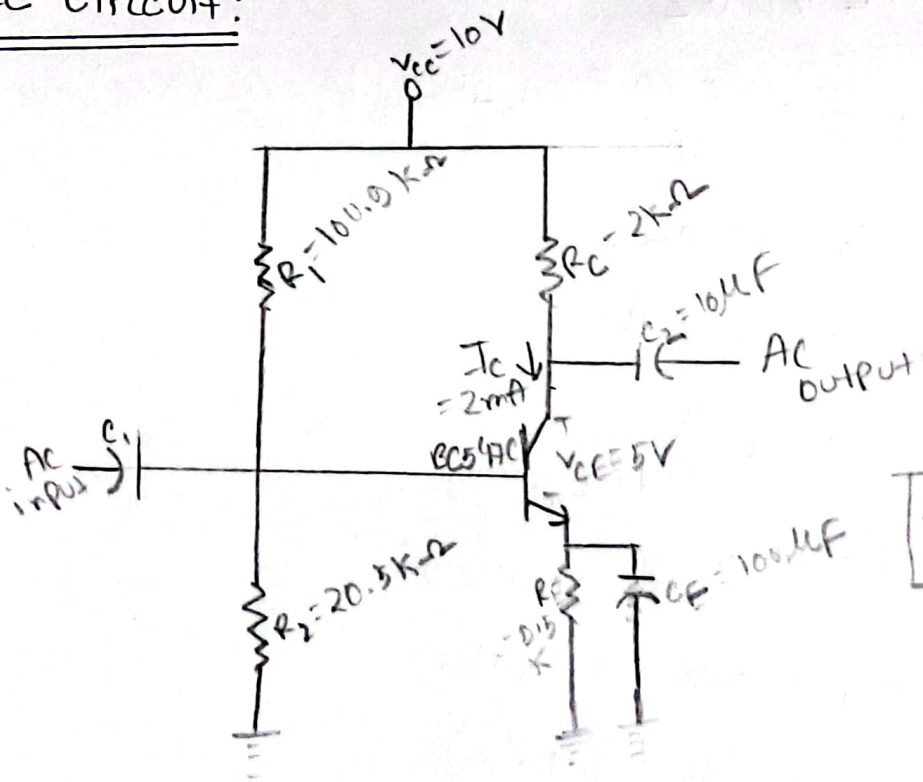
$I_C = 2$ mA

$V_{CE} = 5$ V

$V_{CC} = (5 \times 2)\text{V} = 10$ V

$\beta = 420$

The Circuit:



we know that,

$$V_E = \frac{V_{cc}}{10}$$

$$= \frac{10}{10} = 1\,V$$

Now,

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

$$V_E = I_E R_E$$

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

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

$$= 0.5\,K\Omega$$

Now, $\beta R_E \gg 10 R_2$

$$\therefore R_2 \leq \frac{420 \times 0.5}{10}\,K\Omega$$

$$\therefore R_2 \leq 21\,K\Omega$$

Let, $R_2 = 20.5\,K\Omega$

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

$$\Rightarrow 1.7 = 10 \times \frac{20.5 \times 10^3}{R_1 + 20.5 \times 10^3}$$

$$\therefore R_1 = 100.09\,K\Omega$$

$$V_{CE} = V_{cc} - I_C (R_C + R_E)$$

$$\therefore R_C = \left(\frac{V_{cc} - V_{CE}}{I_C}\right) - R_E = \left(\frac{10-5}{2 \times 10^{-3}}\right) - 0.5 \times 10^3$$

$= 2K\Omega$

Now, $r_e = \frac{26mAV}{I_E} = \frac{26}{2} = 13\Omega$ $[I_E \simeq I_C]$

$R' = R_1 \| R_2 = \left(\frac{1}{100.09} + \frac{1}{20.5}\right)^{-1} = 17.02K\Omega$

$Z_i = R' \| \beta r_e = \left(\frac{1}{17.02\times10^3} + \frac{1}{420\times13}\right)^{-1}$

$= 4133.86\Omega$

$Z_0 = R_C \| R_{Lo} = \left(\frac{1}{2\times10^3} + \frac{1}{10^6}\right)^{-1} = 1996\Omega$

$A_V = -\frac{R_C}{r_e} = \frac{-2000}{13} = -153.85$

$\therefore$ input impedance, $Z_i = 4133.86\Omega$

$\therefore$ output impedance, $Z_0 = 1996\Omega$

$\therefore$ no load voltage gain, $Av = -\frac{R_C}{r_e}$

$= -153.85$

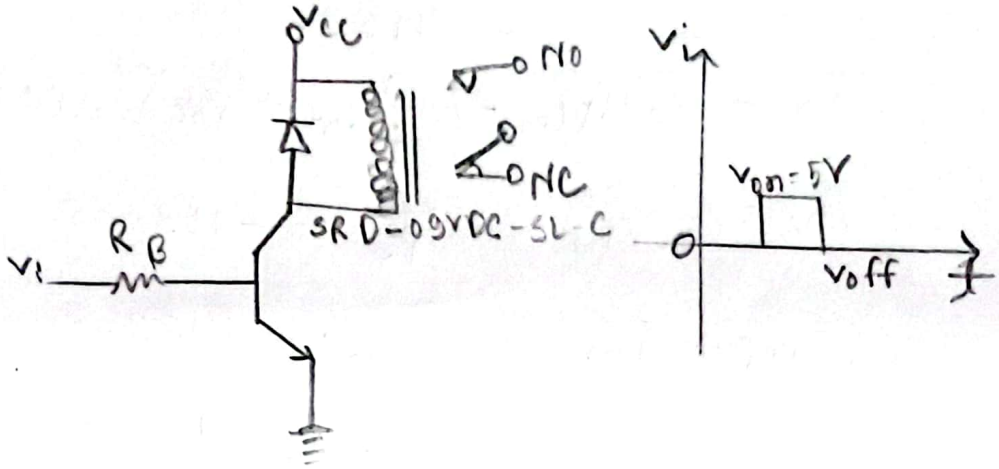
Problem-2:

The sum of the last digit = 0 h

5+4+1 = 10 (even) = 0

Now, I will use the **SRD-09VDC-SL-C** relay.

The circuit diagram of the relay module:



The saturation current from SRD-09VDC-SL-C Datasheet,

$I_{Csat} = 50\,mA$

$V_i = 5V$

The DC current gain of BC547C, $\beta = 430$ [From Datasheet]

$$I_B' = \frac{I_{Csat}}{\beta} = \frac{50mA}{430} = 116.3\,\mu A$$

Let, $I_B = 232.6\,\mu A$ [$\because I_B > I_B'$]

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

$$= \frac{5 - 0.7}{232.6 \times 10^{-6}} = 18.49\,k\Omega$$