EEE 241.7 | Assignment - 2 | Example 4.25

Problem 1

BJT

BC 547C

ID: 172 (even)

$V_{EE} = 5.0V$

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

$I_C = 2.0mA$

$\beta = 420$

From BC547C BJT Datasheet

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

$$R_E = \frac{V_E}{I_E} \approx \frac{V_E}{I_C} = \frac{1V}{2mA} = 500\Omega$$

$$R_C = \frac{V_{CC} - V_{EE} - V_E}{I_C} = \frac{(10-5-1)V}{2} = 2k\Omega$$

$$V_B = V_E + 0.7 = 1V + 0.7V = 1.7V$$

$$R_2 \leq \frac{1}{10}\beta R_E = \frac{1}{10}(420) \times 500 = 21k\Omega$$

$$V_B = \frac{R_2}{R_1 + R_2}(V_{CC}) = \frac{21}{R_1 + 21} \Rightarrow 1.7 = \frac{21}{R_1 + 21} \times 10$$

$\therefore R_1 = 102.5k\Omega$

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

$$R' = R_1 \| R_2 = \left(\frac{1}{102.5} + \frac{1}{21.5}\right)^{-1} = 17.78\,\Omega$$

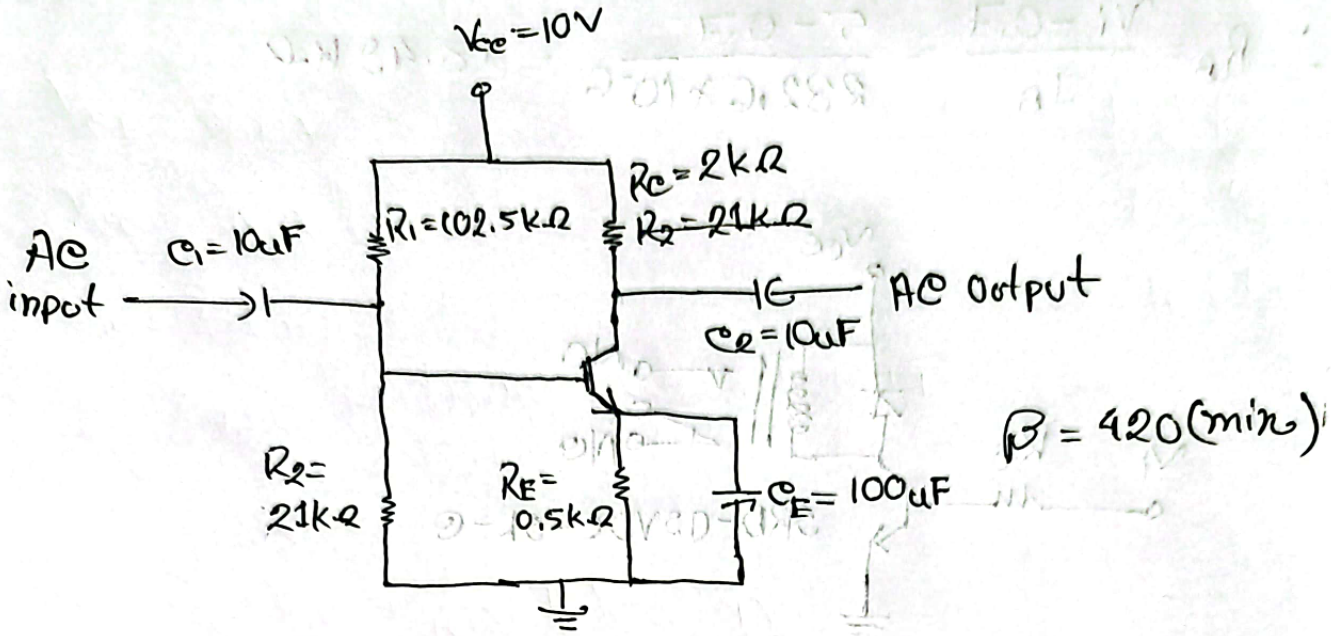
$$Z_i = R' \| \beta r_e = \left(\frac{1}{17.78 \times 10^3} + \frac{1}{420 \times 13}\right)^{-1}$$

$$= 4172.8\,\Omega$$

$$Z_o = R_e \| R_o^{r_o} = \left(\frac{1}{2 \times 10^3} + \frac{1}{100}\right)^{-1}$$

$$= 1996\,\Omega$$

$$A_v = \frac{-R_e}{r_e} = \frac{-2000}{13} = -153.85$$



Problem 2.

Last 3 disit of ID: 172 sum 10 is even.

∴ Relay: SRD-09VDC-SL-C (09 V)

From datasheet,

$I_{csat} = 50mA$

$V_i = 5V$

$\beta = 430$ (BC547C)

$$I'_B = \frac{I_{csat}}{\beta} = \frac{50mA}{430} = 116\,\mu A$$

Let, $I_B = 282.6\,\mu A$ $[\because I_B \geq I'_B]$

$$\therefore R_B = \frac{V_i - 0.7}{I_B} = \frac{5 - 0.7}{232.6 \times 10^{-6}} = 18.49\ K\Omega$$