

EEE 241.7 | Assignment - 2 | Example 4.25

Problem 1

BJT

$$V_{EE} = 5.0V$$

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

$$I_E = 2.0mA$$

$$\beta = 420$$

From BC547C BJT
Datasheet

BC 547C

IO: 172 (even)

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

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

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

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

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

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

$$\therefore R_2 = 102.5k\Omega$$

$$\text{Now, } r_{e} = \frac{26 \text{ mV}}{I_E} = \frac{26}{2} = 13 \Omega$$

$$R' = R_1 || R_2 = \left(\frac{1}{102.5} + \frac{1}{21.5} \right)^{-1} = 17.7 \Omega$$

$$Z_i = R' || \beta r_e = \left(\frac{1}{17.7 \times 10^3} + \frac{1}{420 \times 13} \right)^{-1} = 4172.8 \Omega$$

$$Z_o = R_e || R_o = \left(\frac{1}{2 \times 10^3} + \frac{1}{10^6} \right)^{-1} = 1996 \Omega$$

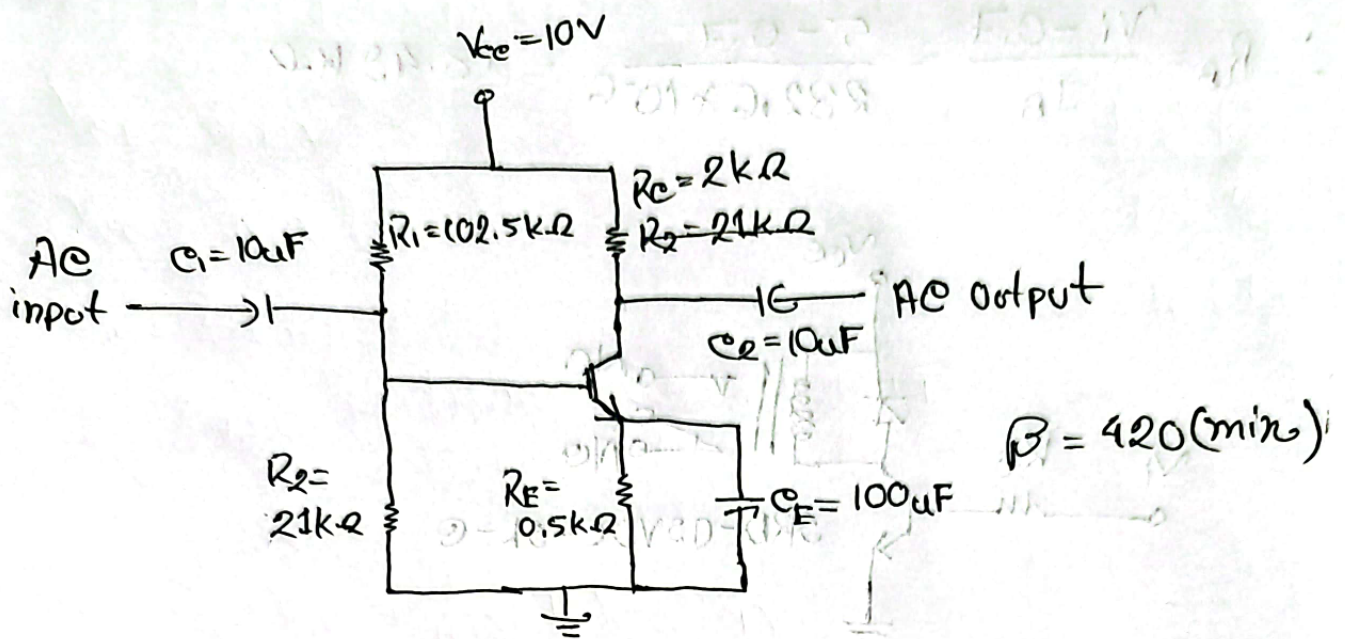
$$A_v = \frac{-R_e}{r_e} = \frac{-2000}{13} = -153.85$$

$$V_{F.D} = V_{F.O} + V_D = 5V + 0.7V = 5.7V$$

$$R_s \leq \frac{1}{10} \beta r_e = \frac{1}{10} (420) \times 200 = 84K\Omega$$

$$V_o = \frac{R_s}{R_s + R_i} (V_{in}) = \frac{R_s}{R_s + R_i} \times 10 \times \frac{R_i}{R_i + R_o} = 1.7$$

$$\therefore R_s = 105.2K\Omega$$



Problem 2.

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

∴ Relay: 5RD-09VDC-SL-C (09 V)

From datasheet,

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

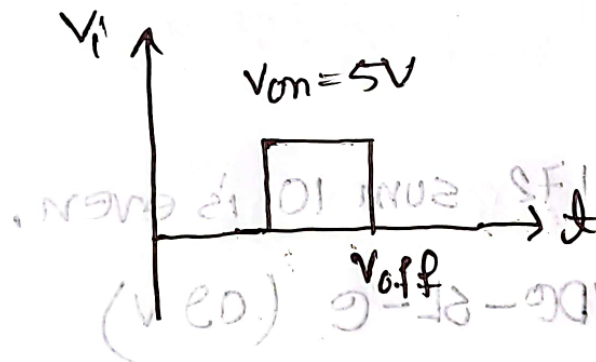
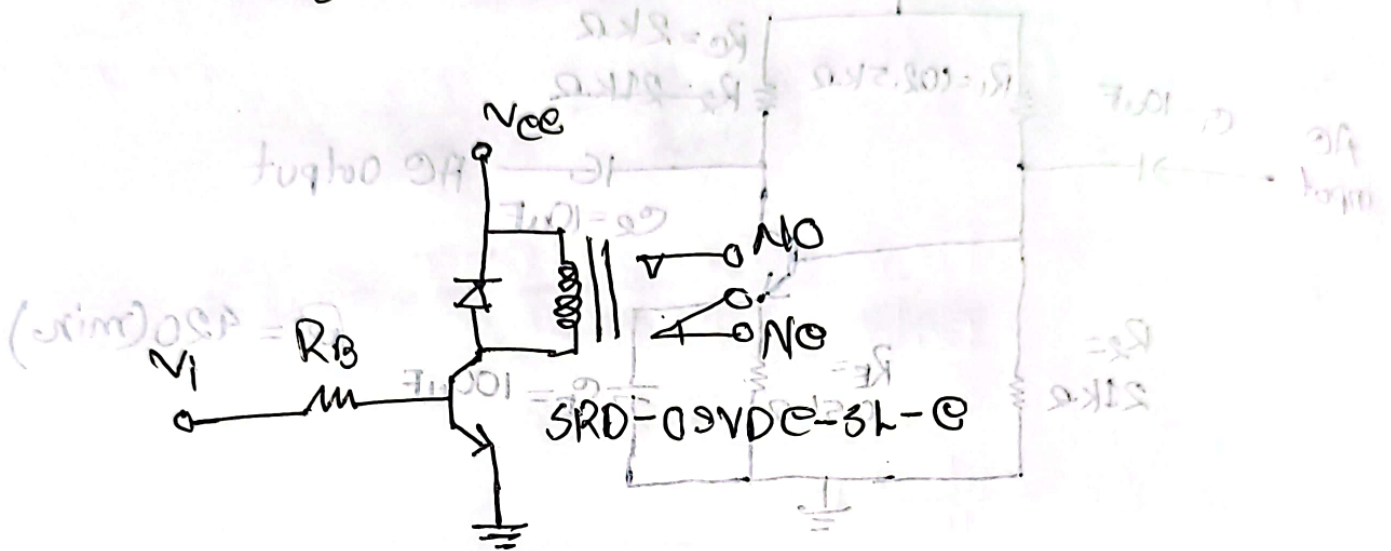
$$V_i = 5 \text{ V}$$

$$\beta = 430 \text{ (} \beta \text{ @ 5470)}$$

$$I'_B = \frac{I_{C_{sat}}}{\beta} = \frac{50 \text{ mA}}{430} = 116 \mu\text{A}$$

$$\text{Let, } I_B = 232.6 \mu\text{A} \quad [\because I_B \geq I'_B]$$

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



From data sheet
 $I_{CQ} = 20 \text{ mA}$

$$V_i = 5 \text{ V}$$

$$V_{CE} = 10 \text{ V}$$

$$A_{v, \text{mid}} = \frac{A_{mid}}{OSF} = \frac{I_{CQ}}{I_B} = \frac{20 \text{ mA}}{232.6 \times 10^{-6}} = 86$$