COMSATS University Islamabad, Lahore Campus

Department of Electrical & Computer Engineering

ASSIGNMENT 2 – Semester SPRING 2024

Course Title:	Electronic Devices and circuits	Course Code:	CPE-231	Credit Hours:	4(3,1)
Course Instructor:	Wajeeha Khan	Program Name:	BCE		
Assignment Date:	28	**Submission Date:**			
Total Marks:	25	Obtained Marks:			
Student's Name:	Aliyan Ahmed Cheema	Reg. No.	FA22-BCE-028		

Note:

- Solve all the questions on A4 pages, two sides.
- Add this assignment page as the front page of your assignment.
- ***All copied assignments (cheating) will be marked zero.***
- ***Sign each page before taking picture and uploading***
- ***Handmade assignments only***
- ***Picture must be clear***

Question 1: (CLO2-PLO2) **(5 Marks)**

Analyse the circuit of Figure 1. to find voltage at each node and current through every branch i.e. V_B, V_C, V_E, I_C, I_B, I_E, α, V_{CE}, I_{Cmax} .

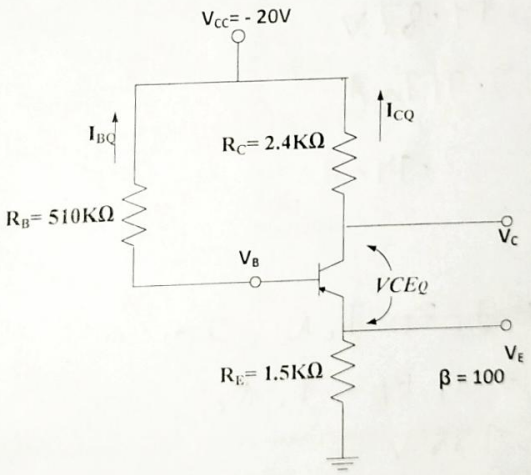
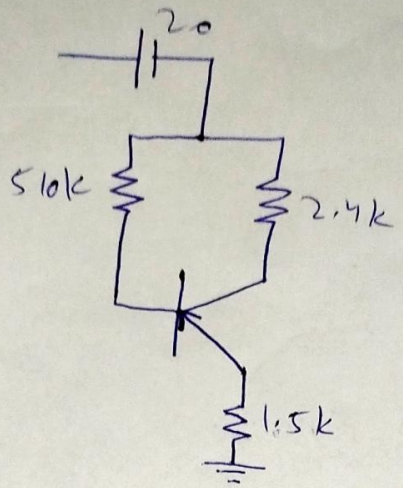


Figure 1.

Q1



Loop I_B,

$$I_E R_E + V_{EB} + R_B I_B - 20 = 0$$

$$I_B(\beta+1)R_E + V_{EB} + R_B I_B - 20 = 0$$

$$I_B = \frac{20 - 0.7}{510k + (\beta+1)1.5k} = 29.17\,\mu A$$

$$V_B = I_B R_B = 14.87\,V$$

$$I_C = \beta I_B = 2.917\,mA$$

$$I_E = (\beta+1) I_B = 2.94\,mA$$

Loop 2,

$$I_E R_E + V_{EC} + I_E R_E\ I_C R_C - 20 = 0$$

$$V_{EC} = 20 - I_E R_E - I_C R_C$$

$$V_{EC} = 8.5988\,V$$

$$V_{CE} = -8.5988\,V$$

$$V_B = 0.7\,V$$

$$V_E = I_E R_E = 2.94\,mA \times 1.5\,k = 4.41\,V$$

Now,

$$V_{CE} = V_C - V_E$$

$$V_C = V_{CE} + V_E = -8.5988 + 4.41 = -4.18\,V$$

Question 2- (CLO2-PLO2) (5 Marks)

Analyze the circuit of figure 2 to find V_{CE}, V_{BE} and V_{CB} in the circuit given in Figure 2.

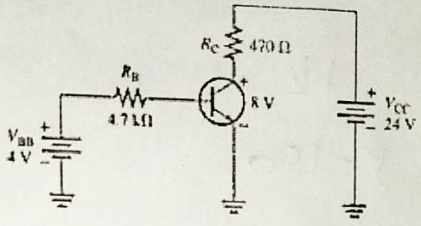


Figure 2.

Question 3- (CLO2-PLO2) (5 Marks)

Analyze the circuit of Figure 3 to find I_C and V_{EC} for the *pnp* transistor circuit in Figure 3.

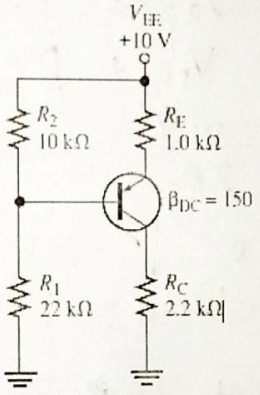


Figure 3.

Question 4- (CLO1-PLO1) (5 Marks)

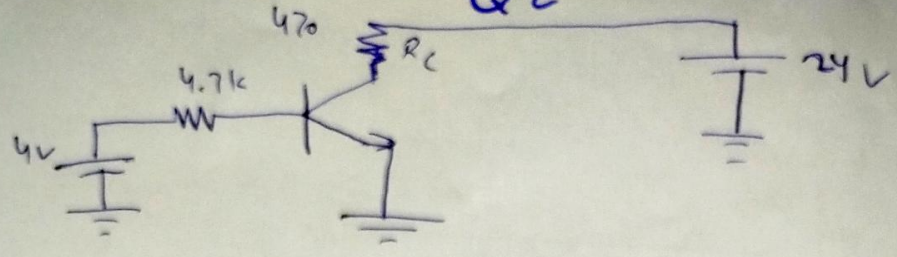
From the collector characteristic curves and the dc load line in Figure 4, **Identify** the following:

(a) Collector saturation current

(b) V_{CE} at cutoff

(c) Q-point values of I_B, I_C, and V_{CE}

Q2



Input loop,

$\therefore V_{BE} = 0.7V$

$-4 + I_B \times 4.7k + V_{BE} = 0$

$I_B = \frac{3.3}{4.7k}$ $\quad I_B = 0.7mA$

Output loop,

$-24 + I_C R_C + 8 = 0$

$I_C = \frac{-8 + 24}{RC} \Rightarrow \frac{16}{470} \Rightarrow 0.03A$

$I_C = 0.03A$

$V_{CE} = 8V$

$V_{CE} = V_C - V_E$ $\quad \therefore V_E = 0$

$V_C = 8V$

$V_{CB} = V_C - V_B = 8 - 0.7 = 7.3$

~~$V_B = V_C - V_{CB}$~~ $V_{CB} = 7.3V$

$V_{BE} = $ ~~$8 - 0.7$~~ $V_B - V_E$

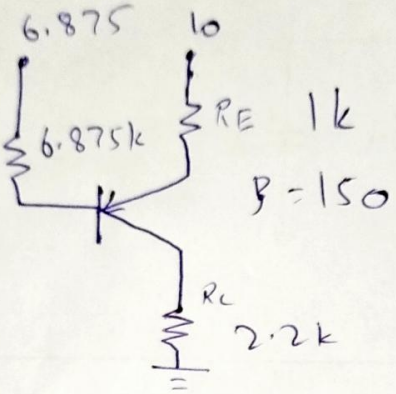
$V_{BE} = 0.7V$

Q-3

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

$$= \frac{22k}{22k+10k} \times 10 = 6.875\ V$$

$$R_{th} = R_1 \| R_2 = \frac{R_1 \times R_2}{R_1+R_2} = 6875\ \Omega = 6.875k\Omega$$



Loop I_B,

$$-6.875 + I_B R_B + V_{BE} + I_C R_C = 0$$

$$-6.875 + I_B R_B + V_{BE} + \beta I_B R_C = 0$$

$$I_B = \frac{6.875 - 0.7}{R_B + \beta R_C} = 18.3\ \mu A$$

Loop 2,

$$I_C = \beta I_B = \boxed{2.745\ mA}$$

$$I_E = (\beta+1) I_B = 2.7633\ mA$$

$$-10 + I_E R_E + V_{EC} + I_C R_C = 0$$

$$V_{EC} = 10 - I_C R_C - I_E R_E$$

$$\boxed{V_{EC} = 1.1977\ V}$$

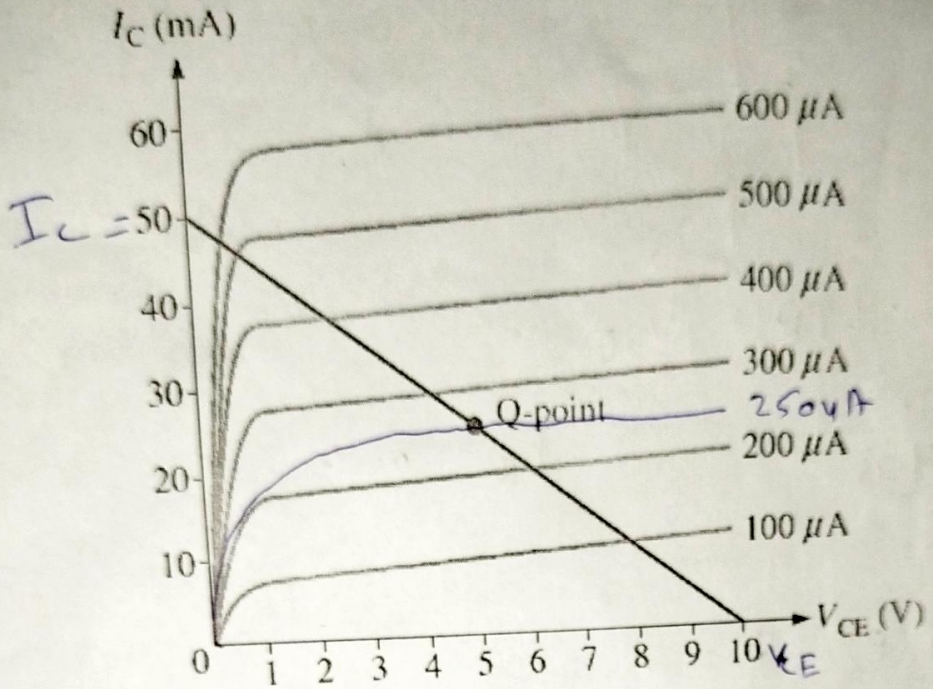


Figure 4.

$I_B = 250\ \mu A$

$V_{CEQ} = 5\ V$

$I_{CQ} = 25\ mA$

Q5

(a) $I_{C_{max}} = 50mA$

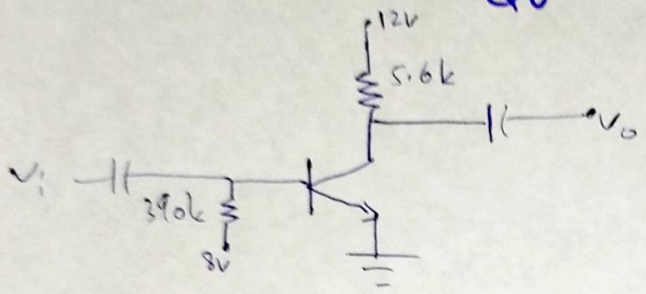
(b) $V_{CE\ cutoff} = 10V$

(c) $I_C = 25mA$

$I_B = 250\mu A$

$V_{CE} = 5V$

Q6



Applying DC analysis,

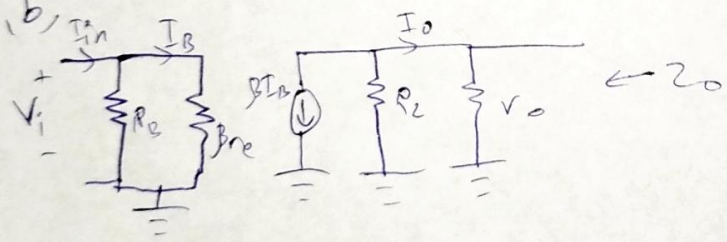
$-8 - I_B(390k) + V_{BE} = 0$

$I_B = \frac{8-0.7}{390k} = 18.72uA = I_B$

$r_e = \frac{26mV}{(\beta+1)I_B} = \frac{26m}{(101)(8.72\times10^{-6})} = 13.75\Omega = r_e$

$I_C = \beta I_B = 1.872\ mA$

(b)



$Z_i = \beta r_e \| R_B$ But $\beta \times 10(\beta r_o) \ll R_B$ so $Z_i = \beta r_e$

$Z_i = 1375\Omega$

$Z_o = (R_L \| r_o)$ since $5600 \ll r_o$

(c) $A_v = \frac{-R_L}{r_e} = \frac{-5600}{13.75} = -407.27$

(d) $A_v = \frac{-R_L \| r_o}{r_e} = -\frac{(5600 \| 3\times10^4)}{13.75} = -343.21$