Sir Syed University of Engineering & Technology (SSUET)

Computer Engineering Department

Course Name: Basic Electronics

Semester: Spring 2011, 3rd

Batch: 2010(Sections: A,B)

Assignments # 6

Course Responsible

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SIR SYED UNIVERSITY OF ENGINEERING AND TECHNOLOGY
COMPUTER ENGINEERING DEPARTMENT
BASIC ELECTRONICS
2010 BATCH (Sections: A, B)
Last Submission Date: 11th May, 2011.

Assignment # 6

Q1. For the fixed-bias configuration of Fig. 4.1, determine:
(a) I_{BQ}.
(b) I_{CQ}.
(c) V_{CEQ}.
(d) V_C.
(e) V_B.
(f) V_E.

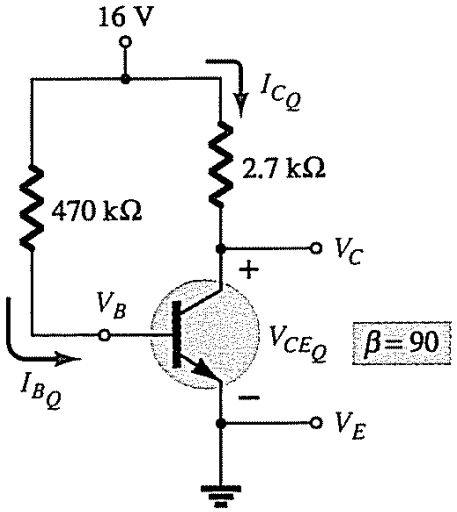

Figure 4.1 Problems 1, and 4.

(a) $I_{B_Q} = \frac{V_{CC} - V_{BE}}{R_B} = \frac{16V - 0.7V}{470k\Omega} = \frac{15.3V}{470k\Omega} = 32.55\mu A$

(b) $I_{C_Q} = \beta I_{B_Q} = (90)(32.55\mu A) = 2.93mA$

(c) $V_{CE_Q} = V_{CC} - I_{C_Q} R_C = 16V - (2.93mA)(2.7k\Omega) = 8.09V$

(d) $V_C = V_{CE_Q} = 8.09V$

(e) $V_B = V_{BE} = 0.7V$

(f) $V_E = 0V$

Q2. Given the information appearing in Fig. 4.2, determine:

(a) I_C.

(b) R_C

(c) R_B.

(d) V_{CE}.

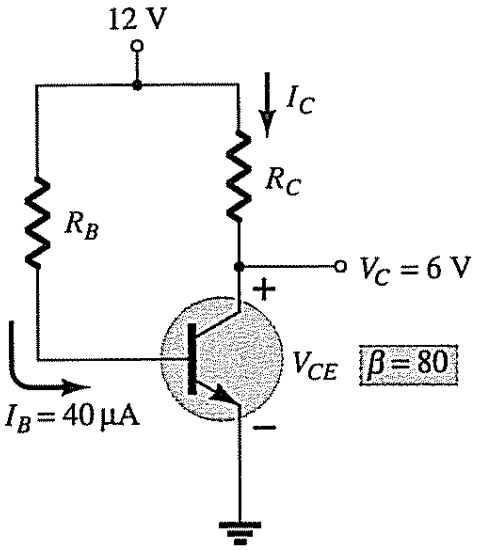

Figure 4.2 Problems 2.

(a) $I_C = \beta I_B = 80(40\mu A) = 3.2mA$

(b) $R_C = \frac{V_{R_C}}{I_C} = \frac{V_{CC} - V_C}{I_C} = \frac{12V - 6V}{3.2mA} = \frac{6V}{3.2mA} = 1.875k\Omega$

(c) $R_B = \frac{V_{R_B}}{I_B} = \frac{12V - 0.7V}{40\mu A} = \frac{11.3V}{40\mu A} = 282.5k\Omega$

(d) $V_{CE} = V_C = 6V$

Q3. Given the information appearing in Fig. 4.3, determine:
(a) I_C.
(b) V_{CC}.
(c) β.
(d) R_B.

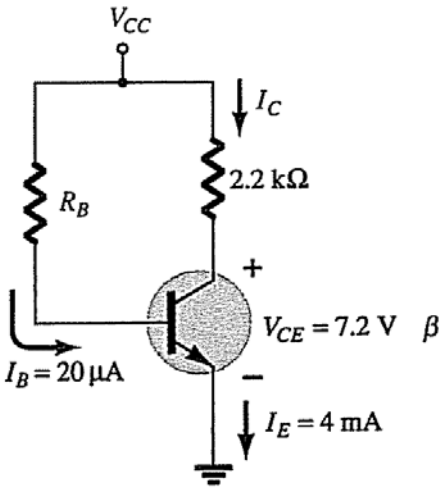

Figure 4.3 Problems 3.

(a) $I_C = I_E - I_B = 4\text{mA} - 20\mu\text{A} = 3.98\text{mA} \cong 4\text{mA}$

(b) $V_{CC} = V_{CE} + I_C R_C = 7.2\text{V} + (3.98\text{mA})(2.2\text{k}\Omega)$
$= 15.96\text{V} \cong 16\text{V}$

(c) $\beta = \frac{I_C}{I_B} = \frac{3.98\text{mA}}{20\mu\text{A}} = 199 \cong 200$

(d) $R_B = \frac{V_{R_B}}{I_B} = \frac{V_{CC} - V_{BE}}{I_B} = \frac{15.96\text{V} - 0.7\text{V}}{20\mu\text{A}} = 763\text{k}\Omega$

Q4. Find the saturation current (I_{Csat}) for the fixed-bias configuration of Fig. 4.1.

$$I_{C_{sat}} = \frac{V_{CC}}{R_C} = \frac{16\text{V}}{2.7\text{k}\Omega} = 5.93\text{mA}$$

Q5. Given the BJT transistor characteristics of Fig. 4.4:
(a) Draw a load line on the characteristics determined by E= 21 V and R_C = 3kΩ for a fixed-bias configuration.
(b) Choose an operating point midway between cutoff and saturation. Determine the value of R_B to establish the resulting operating point.
(c) What are the resulting values of I_{CQ} and V_{CEQ}?
(d) What is the value of β at the operating point?
(e) What is the value of α defined by the operating point?
(f) What is the saturation (I_{Csat}) current for the design?
(g) Sketch the resulting fixed-bias configuration.
(h) What is the dc power dissipated by the device at the operating point?
(i) What is the power supplied by V_{CC}?
(j) Determine the power dissipated by the resistive elements by taking the difference between the results of parts (h) and (i).

(a) Load line intersects vertical vertical axis at $I_C = \frac{21V}{3k\Omega} = 7mA$ and horizontal axis at $V_{CE} = 21V$

(b) $I_B = 25\mu A$: $R_B = \frac{V_{CC} - V_{BE}}{I_B} = \frac{21V - 0.7V}{25\mu A} = \underline{812k\Omega}$

(c) $I_{C_Q} \cong \underline{3.4mA}$, $V_{CE_Q} \cong \underline{10.75V}$

(d) $\beta = \frac{I_C}{I_B} = \frac{3.4mA}{25\mu A} = \underline{136}$

(e) $\alpha = \frac{\beta}{\beta+1} = \frac{136}{136+1} = \frac{136}{137} = \underline{0.992}$

(f) $I_{C_{sat}} = \frac{V_{CC}}{R_C} = \frac{21V}{3k\Omega} = \underline{7mA}$

(g) –

(h) $P_D = V_{CE_Q} I_{C_Q} = (10.75V)(3.4mA) = \underline{36.55mW}$

(i) $P_S = V_{CC}(I_C + I_B) = 21V(3.4mA + 25\mu A) = \underline{71.92mW}$

(j) $P_R = P_S - P_D = 71.92mW - 36.55mW = \underline{35.37mW}$

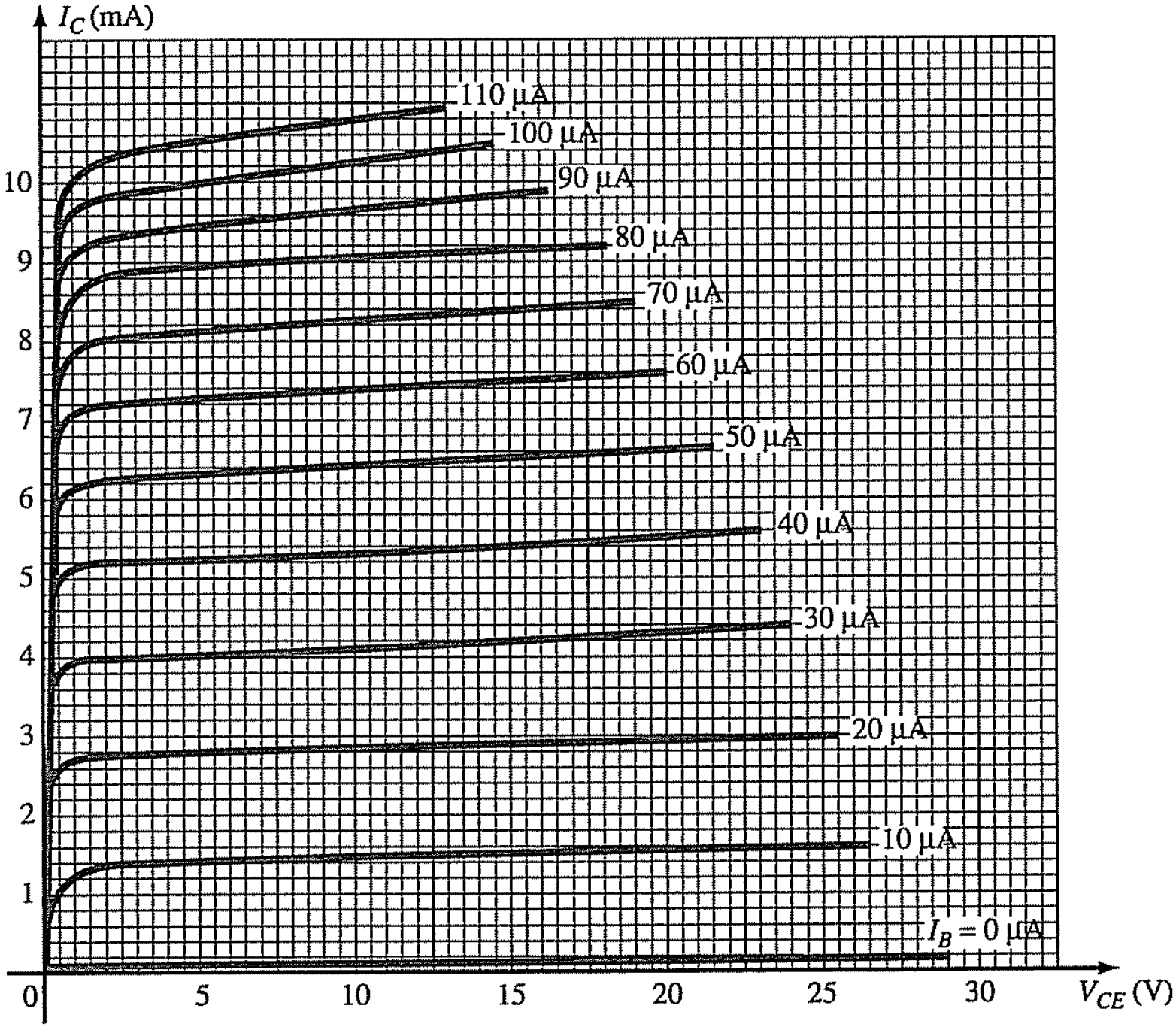

Figure 4.4 Problems 5.