EEEB273 - Quiz 2 [Question Set 1] SEMESTER 1, ACADEMIC YEAR 2013/2014 Date: 8 July 2013 Time: 15 minutes

+5 V

Rc ≤ i_{C2}

vc2

10

24

-5 V

O VB2

+5 V

 $I_{\text{REF}} \downarrow \lessgtr R_1$

Q3

 R_1

 $i_{C1}] \ge R_C$

VCI

Dr JBO Name: Student ID Number: Model Answer Section: 01A / 01B / 02A / 02B Lecturer: Dr. Jamaludin Bin Omar

Question:

*vB*1 0

Study Figure 1 carefully. Assume $\beta = 30$, $V_{BE}(on) = 0.7$ V, and $V_A = \infty$ for all BJTs in the circuit. For $R_C = 2 \text{ k}\Omega$ and $v_{B1} = v_{B2} = 0 \text{ V}$, determine the value of R_1 such that $V_{CE1} = 2.5 \text{ V}$. Write your answers as precise as possible, in 4 decimal points, with proper Units for the parameters.

[10 marks]

[1]



$$= 0 - 0.7 + 2.5$$
 $= 1.8$ v [1]

$$= (5 - v_{C1})/R_C$$
 [1]
= (5 - 1.8) / 2k = 1.6 mA [1]

When
$$v_{B1} = v_{B2} = 0$$
 V:
 $i_{C2} = i_{C1}$

$$I_Q = i_{C1} + i_{C2} = 3.2 \text{ mA}$$
 [1]

$$I_{REF} = I_{\underline{0}} (1+2/\beta)$$
[1]
= (3.2m)(1+2/30) = 3.4133 mA [1]

$$= (V^{+} - V_{RE3}(\text{on}) - V^{-}) / (I_{REE})$$
[1]

$$= (5-0.7-(-5)) / (3.4133 \text{ m}) = 2.7246 \text{ k}\Omega$$
 [1]



Figure 1

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+5 V

 $R_C \ge i_{C2}$

VC2

10

24

Figure 1

-5 V

 $i_{C1}] \ge R_C$

VCI

Name:Dr JBOStudent ID Number:Model AnswerSection:01A / 01B / 02A / 02BLecturer:Dr. Jamaludin Bin Omar

Question:

*vB*1 0

Study Figure 1 carefully. Assume $\beta = 40$, $V_{BE}(on) = 0.7$ V, and $V_A = \infty$ for all BJTs in the circuit. For $R_C = 2 \text{ k}\Omega$ and $v_{B1} = v_{B2} = 0$ V, determine the value of R_1 such that $V_{CE1} = 2.5$ V. Write your answers as precise as possible, in 4 decimal points, with proper Units for the parameters.

> *v*_{C1} *i*_{C1}

O VB2

 $I_{\text{REF}} \downarrow \$$

+5 V

Q3

[10 marks]



$$-0-0.7+2.5$$
 -1.6 V [1]

$$= 5 - i_{C1} R_C$$

$$= (5 - v_{C1})/R_C$$
[1]
= (5 - 1.8) / 2k = 1.6 mA [1]

When
$$v_{P1} = v_{P2} = 0$$
 V.

$$i_{C2} = i_{C1}$$
 [1]
 $I_0 = i_{C1} + i_{C2}$ = 3.2 mA [1]

$$I_{REF} = I_Q (1+2/\beta)$$
[1]
= (3.2m)(1+2/40) = 3.36 mA [1]

$$= (V^{+} - V_{RE3}(\text{on}) - V^{-}) / (I_{REE})$$
[1]

$$= (5-0.7-(-5)) / (3.36 \text{ m}) = 2.7678 \text{ k}\Omega$$
 [1]



EEEB273 - Quiz 2 [Question Set 3] SEMESTER 1, ACADEMIC YEAR 2013/2014 Date: 8 July 2013 Time: 15 minutes

+5 V

Name:Dr JBOStudent ID Number:Model AnswerSection:01A / 01B / 02A / 02BLecturer:Dr.Jamaludin Bin Omar

Question:

Study Figure 1 carefully. Assume $\beta = 40$, $V_{BE}(on) = 0.7$ V, and $V_A = \infty$ for all BJTs in the circuit. For $R_C = 2.5 \text{ k}\Omega$ and $v_{B1} = v_{B2} = 0$ V, determine the value of R_1 such that $V_{CE1} = 2$ V. Write your answers as precise as possible, in 4 decimal points, with proper Units for the parameters.

> v_{C1} i_{C1}

> > R_1

[10 marks]



$$= 5 - i_{C1} R_C$$

$$= (5 - v_{C1})/R_C$$
 [1]

$$= (5 - 1.3) / 2.5k = 1.48 \text{ mA}$$
 [1]

When $v_{B1} = v_{B2} = 0$ V:

$$\begin{aligned} i_{C2} &= i_{C1} & [1] \\ I_Q &= i_{C1} + i_{C2} &= 2.96 \text{ mA} & [1] \end{aligned}$$

$$I_{REF} = I_Q (1+2/\beta)$$
[1]
= (2.96m)(1 + 2/40) = 3.108 mÅ [1]

$$= (2.96 \text{ m})(1 + 2/40) = 3.108 \text{ mA}$$
 [1]

$$= (V^{+} - V_{BE3}(\text{on}) - V^{-}) / (I_{REF})$$
[1]

$$= (5-0.7-(-5)) / (3.108 \text{ m}) = 2.9922 \text{ k}\Omega$$
[1]

$$g_m = \frac{I_{CQ}}{V_T}$$
$$r_o = \frac{V_A}{I_{CQ}}$$

 $i_{C1} \downarrow R_C \qquad R_C \downarrow i_{C2}$ $v_{B1} \bigcirc Q_1 \qquad Q_2 \qquad v_{B2}$ $\downarrow I_Q \qquad +5 V$ $I_{REF} \downarrow R_1$ $Q_4 \qquad Q_3$ -5 V

Figure 1

EEEB273 - Quiz 2 [Question Set 4] SEMESTER 1, ACADEMIC YEAR 2013/2014 Date: 8 July 2013 Time: 15 minutes

+5 V

Re

 $i_{C1}] \ge R_C$

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Question:

Study Figure 1 carefully. Assume $\beta = 30$, $V_{BE}(on) = 0.7$ V, and $V_A = \infty$ for all BJTs in the circuit. For $R_C = 2.5 \text{ k}\Omega$ and $v_{B1} = v_{B2} = 0$ V, determine the value of R_1 such that $V_{CE1} = 2$ V. Write your answers as precise as possible, in 4 decimal points, with proper Units for the parameters.

> v_{C1} i_{C1}

> > R_1

[10 marks]



$$= 5 - ic_1 R_c$$

$$= (5 - v_{C1}) / R_C$$
 [1]

$$= (5 - 1.3) / 2.5k = 1.48 \text{ mA}$$
 [1]

When $v_{B1} = v_{B2} = 0$ V:

$$i_{C2} = i_{C1}$$
 [1]
 $I_Q = i_{C1} + i_{C2}$ = 2.96 mA [1]

$$I_{REF} = I_{\underline{0}} (1+2/\beta)$$
[1]
= (2.96m)(1+2/30) = 3.1573 mÅ [1]

$$= (2.96 \text{ m})(1 + 2/30) = 3.15/3 \text{ mA}$$
 [1]

$$= (V^{+} - V_{BE3}(\text{on}) - V^{-}) / (I_{REF})$$
[1]

$$= (5-0.7-(-5)) / (3.1573 \text{ m}) = 2.9455 \text{ k}\Omega$$
 [1]

$$g_m = \frac{I_{CQ}}{V_T}$$
$$r_o = \frac{V_A}{I_{CQ}}$$

 v_{B1} Q_1 v_{C1} v_{C2} Q_2 v_{B2} $\downarrow I_Q$ +5 V I_{REF} $\downarrow R_1$ Q_4 Q_3 -5 V

