EEEB273 - Quiz 2 [Question Set 1] SEMESTER 3, ACADEMIC YEAR 2011/2012 Date: 22 February 2012 Name:Dr JBOStudent ID Number:Model AnswerSection:01A / 01BLecturer:Dr. Jamaludin Bin Omar

# **Question:**

Given that matched **npn transistors** are available with the parameters:  $I_s = 5 \times 10^{-16} \text{ A}$ ,  $\beta = 70$ , and  $V_A = 150 \text{ V}$ . Power supplies used to power the circuit are:  $V^+ = 7.5 \text{ V}$  and  $V^- = -7.5 \text{ V}$ .

- (a) Find  $V_{BE}($ on) of the transistor. [1.5 marks]
- (b) **Design** a two-transistor current source to provide a constant current of  $I_0 = 0.8$  mA using the available npn transistors mentioned above. [3.5 marks]
- (c) Find the output resistance  $(R_0)$  of the two-transistor current source. [2 marks]
- (d) **Draw** the complete **circuit diagram** for the design of the two-transistor current source. [3 marks]

### Show clearly all calculations, complete with appropriate Units for all variables used.

		<b>V</b>	$-V \ln (I/I)$	[0.5]	$\sqrt{100} = 0.25 \text{ marks}$
(8	1)	$V_{BE}$	$= V_T \ln \left( I_O / I_S \right)$	[0.5]	(d) (i) (i) (i) (i) (i) (i) (i) (i) (i) (i
			$= (0.026) \ln (0.8 \text{m}/5 \text{x} 10^{-16})$	[0.5]	+7.5 V
			= 0.7306 V	[0.5]	
					$\sqrt{\sqrt{1}}$
	<b>)</b> )	I <sub>REF</sub>	$=I_O\left(1+2/\beta\right)$	[0.5]	$I_{\rm REE} = R_1 [17.338  {\rm k}\Omega] + I_{C2} = I_0$
1.6	)	I REF			$I_{\text{REF}} \neq R_1$ 17.338 kΩ
			= (0.8m)(1 + 2/70)	[0.5]	
			= 0.823 mA	[0.5]	
		$R_1$	$= (V^{+} - V_{BE} - V^{-}) / I_{REF}$	[1]	$\sqrt{\sqrt{Q_1}}$
		1	= (7.5 - 0.7306 - (-7.5)) / (0.823m)	[0.5]	
			= 17.338 kΩ	[0.5]	
			= 17.550 KH	[0.0]	
		-	/-		<u> </u>
) (	:)	$R_O$	$= r_{o2} = V_A / I_O$	[1]	-7.5 V
			= (150) / (0.8m)	[0.5]	
			= 187.5 kΩ	[0.5]	$\checkmark$
				[]	
1					

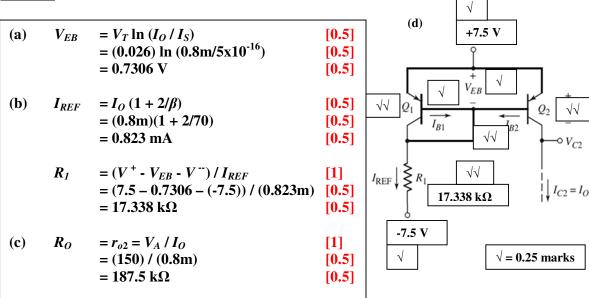
EEEB273 - Quiz 2 [Question Set 2] SEMESTER 3, ACADEMIC YEAR 2011/2012 Date: 22 February 2012 Name:Dr JBOStudent ID Number:Model AnswerSection:01A / 01BLecturer:Dr. Jamaludin Bin Omar

# **Question:**

Given that matched **pnp transistors** are available with the parameters:  $I_s = 5 \times 10^{-16} \text{ A}$ ,  $\beta = 70$ , and  $V_A = 150 \text{ V}$ . Power supplies used to power the circuit are:  $V^+ = 7.5 \text{ V}$  and  $V^- = -7.5 \text{ V}$ .

- (a) Find  $V_{EB}($ on) of the transistor. [1.5 marks]
- (b) **Design** a two-transistor current source to provide a constant current of  $I_0 = 0.8$  mA using the available pnp transistors mentioned above. [3.5 marks]
- (c) Find the output resistance  $(R_0)$  of the two-transistor current source. [2 marks]
- (d) **Draw** the complete **circuit diagram** for the design of the two-transistor current source. [3 marks]

### Show clearly all calculations, complete with appropriate Units for all variables used.



EEEB273 - Quiz 2 [Question Set 3] SEMESTER 3, ACADEMIC YEAR 2011/2012 Date: 22 February 2012 Name:Dr JBOStudent ID Number:Model AnswerSection:01A / 01BLecturer:Dr. Jamaludin Bin Omar

# **Question:**

Given that matched **npn transistors** are available with the parameters:  $I_S = 5 \times 10^{-16} \text{ A}$ ,  $\beta = 50$ , and  $V_A = 100 \text{ V}$ . Power supplies used to power the circuit are:  $V^+ = 7.5 \text{ V}$  and  $V^- = -7.5 \text{ V}$ .

- (a) Find  $V_{BE}($ on) of the transistor. [1.5 marks]
- (b) **Design** a two-transistor current source to provide a constant current of  $I_0 = 0.8$  mA using the available npn transistors mentioned above. [3.5 marks]
- (c) Find the output resistance  $(R_0)$  of the two-transistor current source. [2 marks]
- (d) **Draw** the complete **circuit diagram** for the design of the two-transistor current source. [3 marks]

### Show clearly all calculations, complete with appropriate Units for all variables used.

(a)	V <sub>BE</sub>	$= V_T \ln \left( I_O / I_S \right)$	[0.5]	(d) $$ $$ = 0.25 marks
(4)	' DE	$= (0.026) \ln (0.8 \text{m}/5 \text{x} 10^{-16})$	[0.5]	+7.5 V
		= 0.7306 V	[0.5]	
(b)	I <sub>REF</sub>	$=I_{0}\left(1+2/\beta\right)$	[0.5]	$I_{\text{REF}} \downarrow \lessapprox R_1  \mathbf{17.150 \ k\Omega}  \downarrow  I_{C2} = I_O$
(~)	- KLI	= (0.8m)(1 + 2/50)	[0.5]	
		= 0.832 mA	[0.5]	$\sqrt{\sqrt{1-2}}$
	$R_1$	$= (V^{+} - V_{BE} - V^{-}) / I_{REF}$	[1]	$\begin{array}{c c} & & & \\ \hline \\ \hline$
		= (7.5 - 0.7306 - (-7.5)) / (0.832m)		
		= 17.150 kΩ	[0.5]	
(c)	$R_O$	$= r_{o2} = V_A / I_O$	[1]	-7.5 V
	0	= (100) / (0.8m)	[0.5]	
		$= 125 \text{ k}\Omega$	[0.5]	$\sim$

EEEB273 - Quiz 2 [Question Set 4] SEMESTER 3, ACADEMIC YEAR 2011/2012 Date: 22 February 2012 Name:Dr JBOStudent ID Number:Model AnswerSection:01A / 01BLecturer:Dr. Jamaludin Bin Omar

# **Question:**

Given that matched **pnp transistors** are available with the parameters:  $I_s = 5 \times 10^{-16} \text{ A}$ ,  $\beta = 50$ , and  $V_A = 100 \text{ V}$ . Power supplies used to power the circuit are:  $V^+ = 7.5 \text{ V}$  and  $V^- = -7.5 \text{ V}$ .

- (a) Find  $V_{EB}(on)$  of the transistor. [1.5 marks]
- (b) **Design** a two-transistor current source to provide a constant current of  $I_0 = 0.8$  mA using the available pnp transistors mentioned above. [3.5 marks]
- (c) Find the output resistance  $(R_0)$  of the two-transistor current source. [2 marks]
- (d) **Draw** the complete **circuit diagram** for the design of the two-transistor current source. [3 marks]

Show clearly all calculations, complete with appropriate Units for all variables used.

1					(d)
	(a)	V <sub>EB</sub>	= $V_T \ln (I_O / I_S)$ = (0.026) ln (0.8m/5x10 <sup>-16</sup> ) = 0.7306 V	[0.5] [0.5] [0.5]	
	(b)	I <sub>REF</sub>	= $I_O (1 + 2/\beta)$ = (0.8m)(1 + 2/50) = 0.832 mA	[0.5] [0.5] [0.5]	$\begin{array}{c c} & & & & \\ \hline \\ \hline$
		<i>R</i> <sub>1</sub>	= $(V^+ - V_{EB} - V^-) / I_{REF}$ = $(7.5 - 0.7306 - (-7.5)) / (0.832m)$ = $17.150 \text{ k}\Omega$	[1] [0.5] [0.5]	$I_{\text{REF}} \downarrow \gtrless R_1 \qquad \qquad$
	(c)	R <sub>0</sub>	$= r_{o2} = V_A / I_O$ = (100) / (0.8m) = 125 kΩ	[1] [0.5] [0.5]	$ \begin{array}{c} \circ \\ \hline -7.5 \text{ V} \\ \hline  \end{array} $ $ \begin{array}{c} \checkmark = 0.25 \text{ marks} \end{array} $