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

EEEB273 - Quiz 5 [Question Set 1]
SEMESTER 3, ACADEMIC YEAR 2011/2012
Date: 10 April 2012

Question:

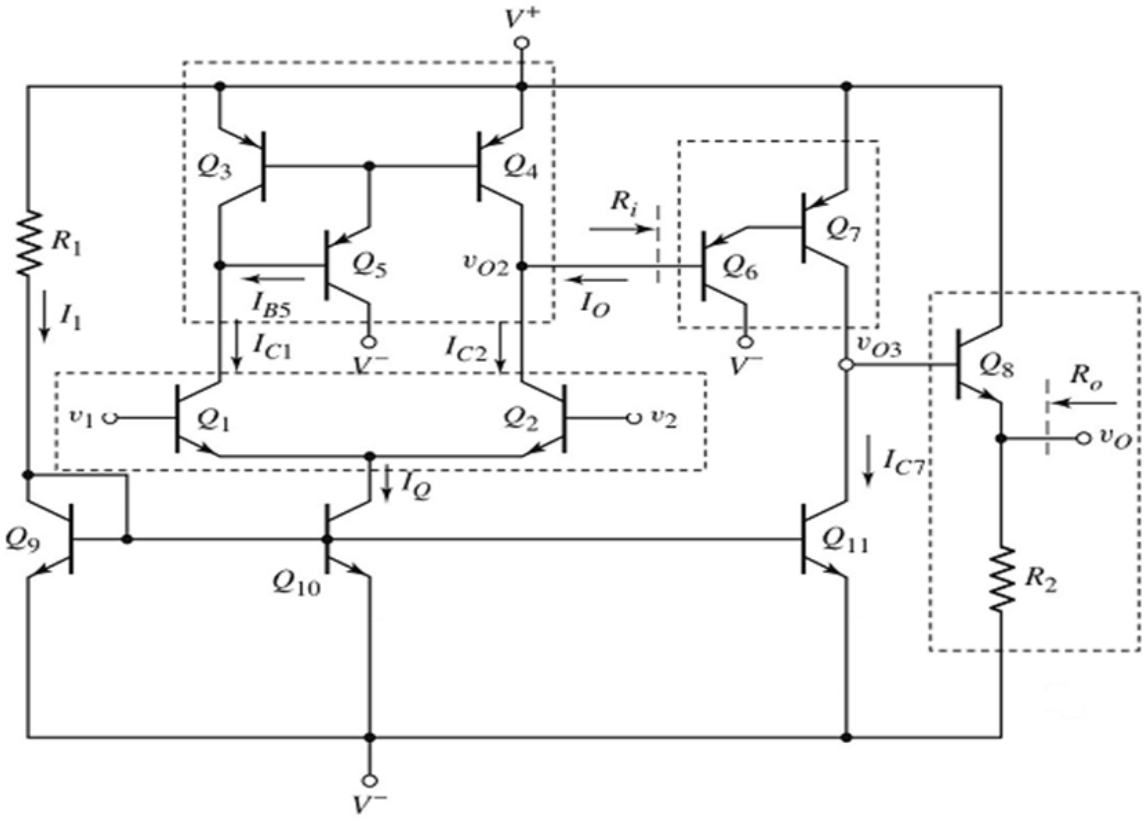

Figure 1

Consider the circuit shown in **Figure 1**, with parameters $I_{C7} = I_Q = 0.2$ **mA**, $I_{C8} = 1$ **mA,** and $R_2 = 12$ **kΩ**. Study the figure carefully. *Note that biasing for amplifiers in the circuit is provided by* ***two-transistor current mirrors***. Assume that $\beta = 120$ for all transistors, and the **Early voltage** for Q_{11} is **100 V**.

(i) **Calculate** the input resistance (R_i) of the **Darlington pair**.

[5 marks]

(ii) **Calculate** the output resistance (R_O) of the **Emitter follower**.

[5 marks]

Answer:

$R_i = [2\,(1+\beta)\,\beta\,V_T] / I_Q$ [3]
→ $R_i = [2\,(1+120)(120)(0.026)] / (0.2\text{m}) = 3.7752\ \text{M}\Omega$ [2]

$R_O = R_2 \parallel \{[r_{\pi 8} + (R_{c11} \parallel R_{c7})]/[(1+\beta)]\}$ [1]
$R_{c11} = r_{o11} = V_{A11} / I_{c11} = V_{A11} / I_Q = 100/0.2\text{m} = 500\ \text{k}\Omega$ [1]
$R_{c7} = r_{o7} = V_{A7} / I_{c7} = V_{A7} / I_Q = 100/0.2\text{m} = 500\ \text{k}\Omega$ [1]
$r_{\pi 8} = \beta\,V_T / I_{C8} = (120)(0.026)/(1\text{m}) = 3.12\ \text{k}\Omega$ [1]
→ $R_O = (12\text{k}) \parallel \{[3.12\text{k} + (500\text{k} \parallel 500\text{k})]/[(1+120)]\} = (12\text{k}) \parallel (2.09\text{k}) = 1.78\ \text{k}\Omega$ [1]

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

EEEB273 - Quiz 5 [Question Set 2]
SEMESTER 3, ACADEMIC YEAR 2011/2012
Date: 10 April 2012

Question:

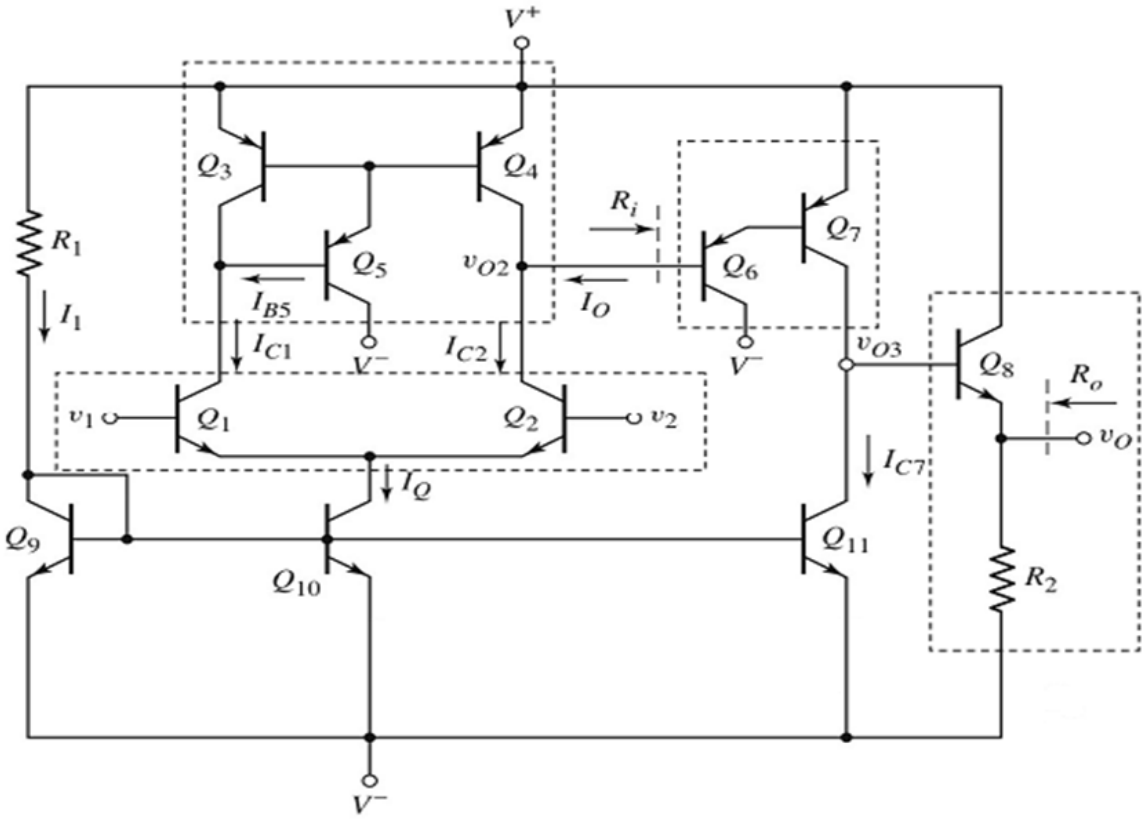

Figure 1

Consider the circuit shown in **Figure 1**, with parameters $I_{C7} = I_Q = 0.2$ **mA**, $I_{C8} = 1.2$ **mA,** and $R_2 =$ **10 kΩ**. Study the figure carefully. *Note that biasing for amplifiers in the circuit is provided by* ***two-transistor current mirrors***. Assume that $\beta = 120$ for all transistors, and the **Early voltage** for Q_{11} is **100 V**.

(i) **Calculate** the input resistance (R_i) of the **Darlington pair**.

[5 marks]

(ii) **Calculate** the output resistance (R_O) of the **Emitter follower**.

[5 marks]

Answer:

$R_i = [2\ (1+\beta)\ \beta\ V_T] / I_Q$ [3]
→ $R_i = [2\ (1+120)(120)(0.026)] / (0.2m) = 3.7752$ MΩ [2]

$R_O = R_2 \parallel \{[r_{\pi 8} + (R_{c11} \parallel R_{c7})]/[(1+\beta)]\}$ [1]
$R_{c11} = r_{o11} = V_{A11} / I_{c11} = V_{A11} / I_Q = 100/0.2m = 500$ kΩ [1]
$R_{c7} = r_{o7} = V_{A7} / I_{c7} = V_{A7} / I_Q = 100/0.2m = 500$ kΩ [1]
$r_{\pi 8} = \beta\ V_T / I_{C8} = (120)(0.026)/(1.2m) = 2.6$ kΩ [1]
→ $R_O = (10k) \parallel \{[2.6k + (500k \parallel 500k)]/[(1+120)]\} = (10k) \parallel (2.08k) = 1.72$ kΩ [1]

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

EEEB273 - Quiz 5 [Question Set 3]
SEMESTER 3, ACADEMIC YEAR 2011/2012
Date: 10 April 2012

Question:

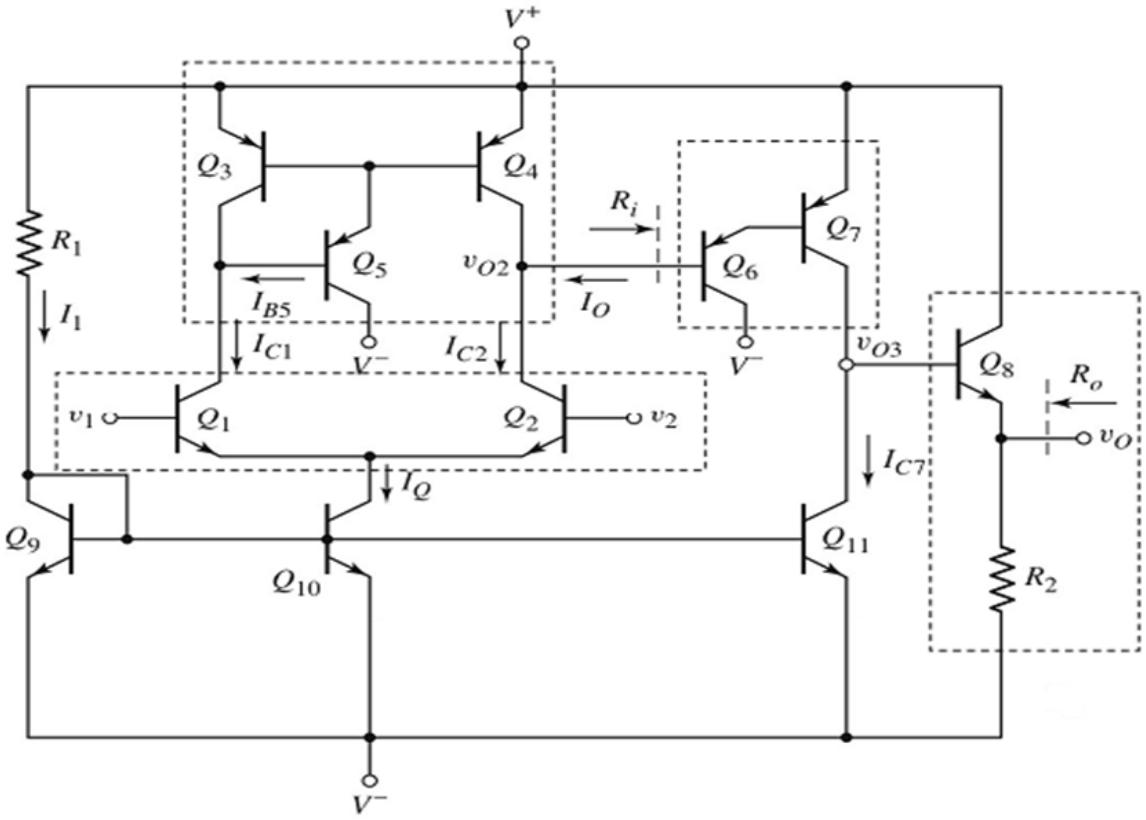

Figure 1

Consider the circuit shown in **Figure 1**, with parameters $I_{C7} = I_Q = 0.2$ **mA**, $I_{C8} = 1.2$ **mA,** and $R_2 = 12$ **kΩ**. Study the figure carefully. *Note that biasing for amplifiers in the circuit is provided by* ***two-transistor current mirrors***. Assume that $\beta = 100$ for all transistors, and the **Early voltage** for Q_{11} is **100 V**.

(i) **Calculate** the input resistance (R_i) of the **Darlington pair**. [5 marks]

(ii) **Calculate** the output resistance (R_O) of the **Emitter follower**. [5 marks]

Answer:

$R_i = [2\,(1+\beta)\,\beta\,V_T] / I_Q$ [3]
→ $R_i = [2\,(1+100)(100)(0.026)] / (0.2\text{m}) = 2.626\ \text{M}\Omega$ [2]

$R_O = R_2 \parallel \{[r_{\pi 8} + (R_{c11} \parallel R_{c7})]/[(1+\beta)]\}$ [1]
$R_{c11} = r_{o11} = V_{A11} / I_{c11} = V_{A11} / I_Q = 100/0.2\text{m} = 500\ \text{k}\Omega$ [1]
$R_{c7} = r_{o7} = V_{A7} / I_{c7} = V_{A7} / I_Q = 100/0.2\text{m} = 500\ \text{k}\Omega$ [1]
$r_{\pi 8} = \beta\,V_T / I_{C8} = (100)(0.026)/(1.2\text{m}) = 2.16\ \text{k}\Omega$ [1]
→ $R_O = (12\text{k}) \parallel \{[2.16\text{k} + (500\text{k} \parallel 500\text{k})]/[(1+100)]\} = (12\text{k}) \parallel (2.49\text{k}) = 2.06\ \text{k}\Omega$ [1]

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

EEEB273 - Quiz 5 [Question Set 4]
SEMESTER 3, ACADEMIC YEAR 2011/2012
Date: 10 April 2012

Question:

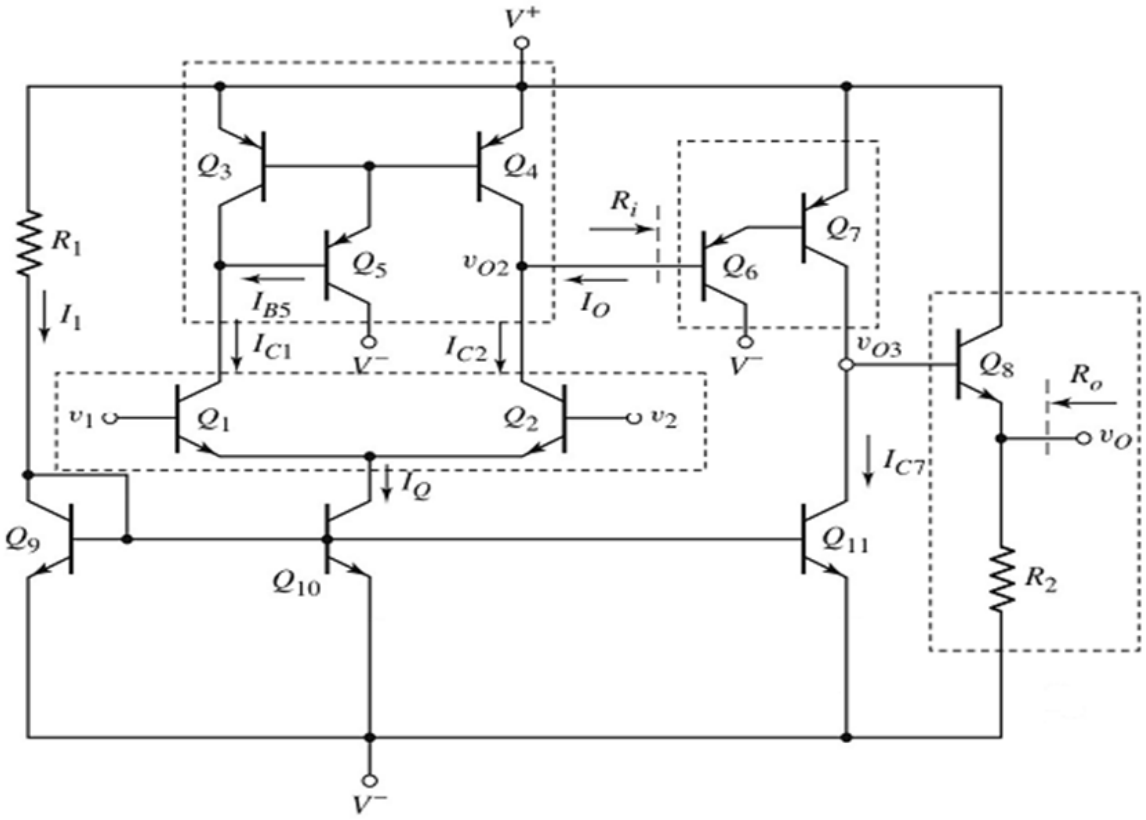

Figure 1

Consider the circuit shown in **Figure 1**, with parameters $I_{C7} = I_Q = 0.2$ **mA**, $I_{C8} = 1$ **mA,** and $R_2 =$ **14 kΩ**. Study the figure carefully. *Note that biasing for amplifiers in the circuit is provided by* ***two-transistor current mirrors***. Assume that $\beta = 120$ for all transistors, and the **Early voltage** for Q_{11} is **100 V**.

(i) **Calculate** the input resistance (R_i) of the **Darlington pair**.

[5 marks]

(ii) **Calculate** the output resistance (R_O) of the **Emitter follower**.

[5 marks]

Answer:

$R_i = [2\,(1+\beta)\,\beta\,V_T] / I_Q$ [3]
→ $R_i = [2\,(1+120)(120)(0.026)] / (0.2\text{m}) = 3.7752\ \text{M}\Omega$ [2]

$R_O = R_2 \parallel \{[r_{\pi 8} + (R_{c11} \parallel R_{c7})]/[(1+\beta)]\}$ [1]
$R_{c11} = r_{o11} = V_{A11} / I_{c11} = V_{A11} / I_Q = 100/0.2\text{m} = 500\ \text{k}\Omega$ [1]
$R_{c7} = r_{o7} = V_{A7} / I_{c7} = V_{A7} / I_Q = 100/0.2\text{m} = 500\ \text{k}\Omega$ [1]
$r_{\pi 8} = \beta\,V_T / I_{C8} = (120)(0.026)/(1\text{m}) = 3.12\ \text{k}\Omega$ [1]
→ $R_O = (14\text{k}) \parallel \{[3.12\text{k} + (500\text{k} \parallel 500\text{k})]/[(1+120)]\} = (14\text{k}) \parallel (2.09\text{k}) = 1.81\ \text{k}\Omega$ [1]