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

EEEB273 - Quiz 3 [Question Set 1]
SEMESTER 1, ACADEMIC YEAR 2012/2013
Date: 14 August 2012

Question:

Figure 1 shows the **ac equivalent circuit** of the input stage of the **741 op-amp.** For all transistors V_A **= 50 V,** β **= 200,** and **neglect** the base currents. Given that I_{C2} **= 5.5 µA,** and $R_1 = R_2$ **= 1 kΩ**. **Determine** the effective output resistance, R_O, looking at v_{o1}. **Neglect** the effective resistances in the emitters of Q_4 and Q_2.

[10 marks]

Answer:

$R_O = r_{O4} \| R_{act1}$ [2]

$I_{C4} = I_{C2} = 5.5\mu A$ [0.5]

$r_{O4} = \dfrac{V_A}{I_{C4}} = \dfrac{50}{5.5\mu} = 9.09M\Omega$ [1]

$R_{act1} = r_{O6}\left[1 + g_{m6}(R_2 \| r_{\pi 6})\right]$ [1]

$I_{C6} = I_{C2} = 5.5\mu A$ [0.5]

$r_{O6} = \dfrac{V_A}{I_{C6}} = \dfrac{50}{5.5\mu} = 9.09M\Omega$ [1]

$g_{m6} = \dfrac{I_{C6}}{V_T} = \dfrac{5.5\mu}{0.026} = 0.2115mA/V^2$ [1]

$r_{\pi 6} = \dfrac{\beta V_T}{I_{C6}} = \dfrac{200(0.026)}{5.5\mu} = 0.945M\Omega$ [1]

$R_{act1} = (9.09M)[1 + (0.2115m)(1k \| 0.945M)]$ [0.5]

$R_{act1} = 11.01M\Omega$ [0.5]

$R_O = 9.09M \| 11.01M\Omega = 4.979M\Omega$ [1]

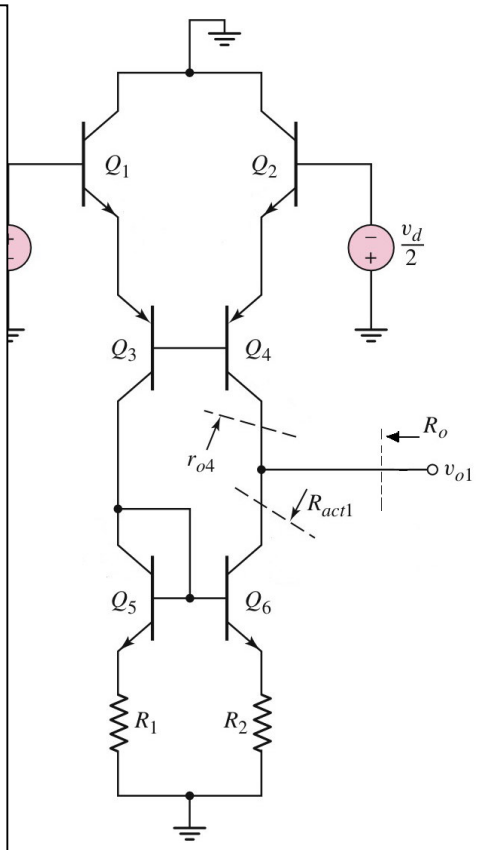

Figure 1

Name:	**Dr JBO**
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EEEB273 - Quiz 3 [Question Set 2]
SEMESTER 1, ACADEMIC YEAR 2012/2013
Date: 14 August 2012

Question:

Figure 1 shows the **ac equivalent circuit** of the input stage of the **741 op-amp.** For all transistors V_A **= 50 V,** β **= 200,** and **neglect** the base currents. Given that I_{C2} **= 5.3 µA,** and $R_1 = R_2$ **= 1 kΩ**. **Determine** the effective output resistance, R_O, looking at v_{o1}. **Neglect** the effective resistances in the emitters of Q_4 and Q_2.

[10 marks]

Answer:

$R_O = r_{O4} \| R_{act1}$ [2]

$I_{C4} = I_{C2} = 5.3\mu A$ [0.5]

$r_{O4} = \dfrac{V_A}{I_{C4}} = \dfrac{50}{5.3\mu} = 9.43M\Omega$ [1]

$R_{act1} = r_{O6}\left[1 + g_{m6}(R_2 \| r_{\pi 6})\right]$ [1]

$I_{C6} = I_{C2} = 5.3\mu A$ [0.5]

$r_{O6} = \dfrac{V_A}{I_{C6}} = \dfrac{50}{5.3\mu} = 9.43M\Omega$ [1]

$g_{m6} = \dfrac{I_{C6}}{V_T} = \dfrac{5.3\mu}{0.026} = 0.2038 mA/V^2$ [1]

$r_{\pi 6} = \dfrac{\beta V_T}{I_{C6}} = \dfrac{200(0.026)}{5.3\mu} = 0.981M\Omega$ [1]

$R_{act1} = (9.43M)[1 + (0.2038m)(1k \| 0.981M)]$ [0.5]

$R_{act1} = 11.35M\Omega$ [0.5]

$R_O = 9.43M \| 11.35M\Omega = 5.151M\Omega$ [1]

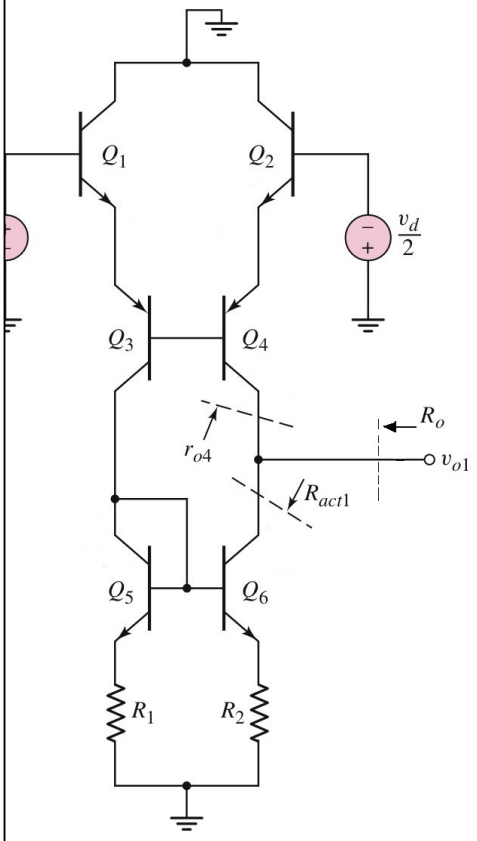

Figure 1

Name:	**Dr JBO**
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Section:	01A / 01B / 02A / 02B
Lecturer:	Dr. Jamaludin Bin Omar

EEEB273 - Quiz 3 [Question Set 3]
SEMESTER 1, ACADEMIC YEAR 2012/2013
Date: 14 August 2012

Question:

Figure 1 shows the **ac equivalent circuit** of the input stage of the **741 op-amp.** For all transistors V_A **= 50 V,** β **= 200,** and **neglect** the base currents. Given that I_{C2} **= 5.7 µA,** and $R_1 = R_2$ **= 1.2 kΩ**. **Determine** the effective output resistance, R_O, looking at v_{o1}. **Neglect** the effective resistances in the emitters of Q_4 and Q_2.

[10 marks]

Answer:

$R_O = r_{O4} \| R_{act1}$ [2]

$I_{C4} = I_{C2} = 5.7\mu A$ [0.5]

$r_{O4} = \dfrac{V_A}{I_{C4}} = \dfrac{50}{5.7\mu} = 8.77M\Omega$ [1]

$R_{act1} = r_{O6}\left[1 + g_{m6}(R_2 \| r_{\pi 6})\right]$ [1]

$I_{C6} = I_{C2} = 5.7\mu A$ [0.5]

$r_{O6} = \dfrac{V_A}{I_{C6}} = \dfrac{50}{5.7\mu} = 8.77M\Omega$ [1]

$g_{m6} = \dfrac{I_{C6}}{V_T} = \dfrac{5.7\mu}{0.026} = 0.2192mA/V^2$ [1]

$r_{\pi 6} = \dfrac{\beta V_T}{I_{C6}} = \dfrac{200(0.026)}{5.7\mu} = 0.9122M\Omega$ [1]

$R_{act1} = (8.77M)[1 + (0.2192m)(1.2k \| 0.9122M)]$ [0.5]

$R_{act1} = 11.076M\Omega$ [0.5]

$R_O = 8.77M \| 11.076M\Omega = 4.894M\Omega$ [1]

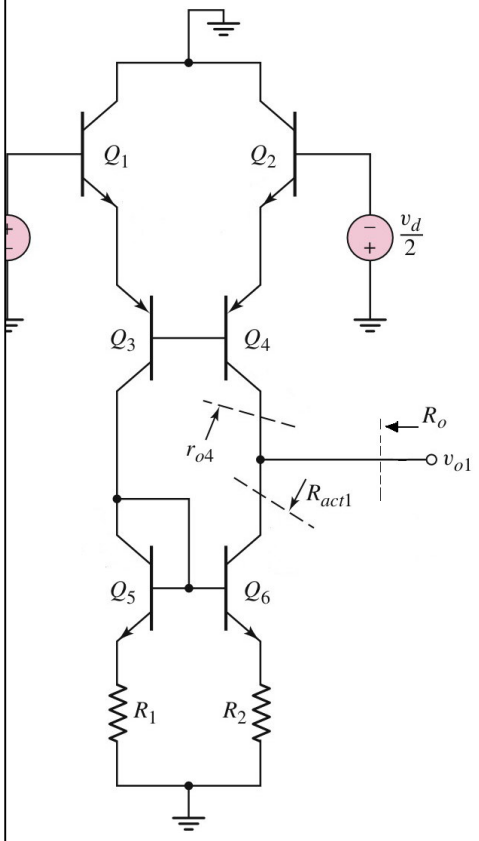

Figure 1

Name:	**Dr JBO**
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Lecturer:	Dr. Jamaludin Bin Omar

EEEB273 - Quiz 3 [Question Set 4]
SEMESTER 1, ACADEMIC YEAR 2012/2013
Date: 14 August 2012

Question:

Figure 1 shows the **ac equivalent circuit** of the input stage of the **741 op-amp.** For all transistors V_A **= 50 V,** β **= 200,** and **neglect** the base currents. Given that I_{C2} **= 5.3 µA,** and $R_1 = R_2$ **= 1.2 kΩ**. **Determine** the effective output resistance, R_O, looking at v_{o1}. **Neglect** the effective resistances in the emitters of Q_4 and Q_2.

[10 marks]

Answer:

$R_O = r_{O4} \| R_{act1}$ [2]

$I_{C4} = I_{C2} = 5.3\mu A$ [0.5]

$r_{O4} = \dfrac{V_A}{I_{C4}} = \dfrac{50}{5.3\mu} = 9.43M\Omega$ [1]

$R_{act1} = r_{O6}\left[1 + g_{m6}(R_2 \| r_{\pi 6})\right]$ [1]

$I_{C6} = I_{C2} = 5.3\mu A$ [0.5]

$r_{O6} = \dfrac{V_A}{I_{C6}} = \dfrac{50}{5.3\mu} = 9.43M\Omega$ [1]

$g_{m6} = \dfrac{I_{C6}}{V_T} = \dfrac{5.3\mu}{0.026} = 0.2038 mA/V^2$ [1]

$r_{\pi 6} = \dfrac{\beta V_T}{I_{C6}} = \dfrac{200(0.026)}{5.3\mu} = 0.981M\Omega$ [1]

$R_{act1} = (9.43M)[1 + (0.2038m)(1.2k \| 0.981M)]$ [0.5]

$R_{act1} = 11.736M\Omega$ [0.5]

$R_O = 9.43M \| 11.736M\Omega = 5.228M\Omega$ [1]

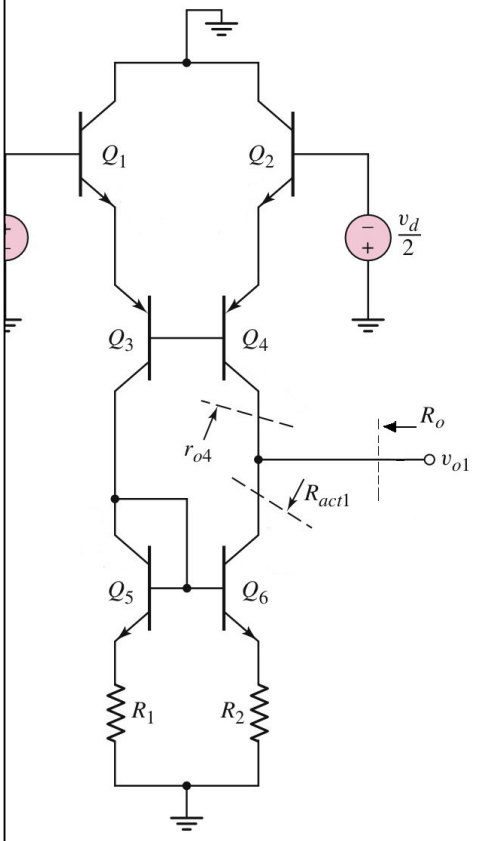

Figure 1