Student ID Number: Model Answer

Section:

Lecturer: Dr. Jamaludin Bin Omar

EEEB273 - Quiz 5

SEMESTER 1, ACADEMIC YEAR 2016/2017

Date: 15 August 2016 Time: 15 minutes

Question:

Study the simple output stage circuit shown in Figure 1 carefully. Let $R_1 = 50 \text{ k}\Omega$, $R_2 = 5 \text{ k}\Omega$, $I_{C2} = 0.5 \text{ mA}$, and $I_{C3} = 1 \text{ mA}$. The transistor parameters are: $\beta = 100$ and $V_A = 120 \text{ V}$. Neglect base currents.

Determine the output resistance (R_0) of the emitter follower Q_3 .

[10 marks]

Write your answer using pen with proper Units for all the parameters. Show clearly all formula used in finding the solution.

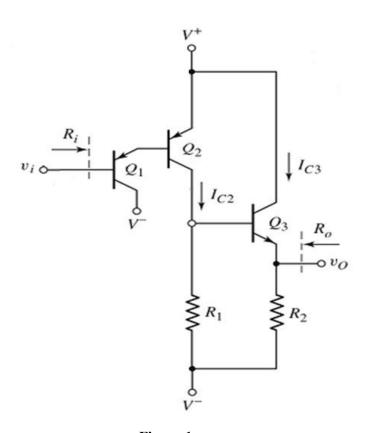


	Figure 1		
R _O Z R _{c2}	= $R_2 \parallel [(r_{\pi 3} + \mathbf{Z}) / (1 + \beta)]$ = $R_1 \parallel R_{c2}$ = $r_{O2} = V_A / I_{C2}$ = $(120 \text{ V})/(0.5 \text{ mA}) = 240 \text{ k}\Omega$	[1.5] [1] [2] [1]	
$egin{array}{c} Z \\ r_{\pi 3} \\ R_O \end{array}$	= $(50 \text{ k}\Omega) \parallel (240 \text{ k}\Omega) = 41.379 \text{ k}\Omega$ = $(\beta V_T) / I_{C3} = (100 \text{ x } 0.026) / 1\text{m} = 2.6 \text{ k}\Omega$ = $(5 \text{ k}\Omega) \parallel [(2.6 \text{ k}\Omega + 41.379 \text{ k}\Omega) / (1 + 100)]$ = 400.55Ω	[1] [2] [1] [0.5]	

$$i_C = I_S e^{v_{BE}/V_T}$$
; npn
 $i_C = I_S e^{v_{EB}/V_T}$; pnp
 $i_C = \alpha i_E = \beta i_B$
 $i_E = i_B + i_C$
 $\alpha = \frac{\beta}{\beta + 1}$

$$\beta = g_m r_{\pi}$$

$$r_{\pi} = \frac{\beta V_T}{I_{CQ}}$$

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

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

$$V_T = 26 \,\mathrm{mV}$$

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SEMESTER 1, ACADEMIC YEAR 2016/2017

Date: 15 August 2016 Time: 15 minutes

Question:

Study the simple output stage circuit shown in Figure 1 carefully. Let $R_1 = 40 \text{ k}\Omega$, $R_2 = 8 \text{ k}\Omega$, $I_{C2} = 0.4 \text{ mA}$, and $I_{C3} = 1 \text{ mA}$. The transistor parameters are: $\beta = 100$ and $V_A = 120 \text{ V}$. Neglect base currents.

Determine the output resistance (R_0) of the emitter follower Q_3 .

[10 marks]

Write your answer using pen with proper Units for all the parameters. Show clearly all formula used in finding the solution.

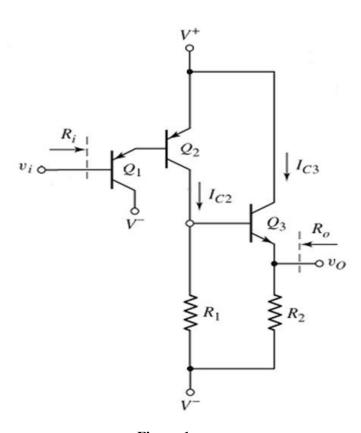


Figure 1

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R_0 Z R_{c2}	= $R_2 \parallel [(r_{\pi 3} + \mathbf{Z}) / (1 + \beta)]$ = $R_1 \parallel R_{c2}$ = $r_{O2} = V_A / I_{C2}$ = $(120 \text{ V})/(0.4 \text{ mA}) = 300 \text{ k}\Omega$	[1.5] [1] [2] [1]
$egin{array}{c} Z \\ r_{\pi 3} \\ R_O \end{array}$	= $(40 \text{ k}\Omega) \parallel (300 \text{ k}\Omega) = 35.294 \text{ k}\Omega$ = $(\beta V_T) / I_{C3} = (100 \text{ x } 0.026) / 1\text{m} = 2.6 \text{ k}\Omega$ = $(8 \text{ k}\Omega) \parallel [(2.6 \text{ k}\Omega + 35.294 \text{ k}\Omega) / (1 + 100)]$ = 358.38Ω	[1] [2] [1] [0.5]

$$i_C = I_S e^{v_{BE}/V_T}$$
; npn
 $i_C = I_S e^{v_{EB}/V_T}$; pnp
 $i_C = \alpha i_E = \beta i_B$
 $i_E = i_B + i_C$
 $\alpha = \frac{\beta}{\beta + 1}$

$$\beta = g_m r_{\pi}$$

$$r_{\pi} = \frac{\beta V_T}{I_{CQ}}$$

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

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

$$V_T = 26 \,\mathrm{mV}$$

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EEEB273 - Quiz 5

SEMESTER 1, ACADEMIC YEAR 2016/2017

Date: 15 August 2016 Time: 15 minutes

Question:

Study the simple output stage circuit shown in Figure 1 carefully. Let $R_1 = 55 \text{ k}\Omega$, $R_2 = 8 \text{ k}\Omega$, $I_{C2} = 0.3 \text{ mA}$, and $I_{C3} = 1 \text{ mA}$. The transistor parameters are: $\beta = 100$ and $V_A = 120 \text{ V}$. Neglect base currents.

Determine the output resistance (R_0) of the emitter follower Q_3 .

[10 marks]

Write your answer using pen with proper Units for all the parameters. Show clearly all formula used in finding the solution.

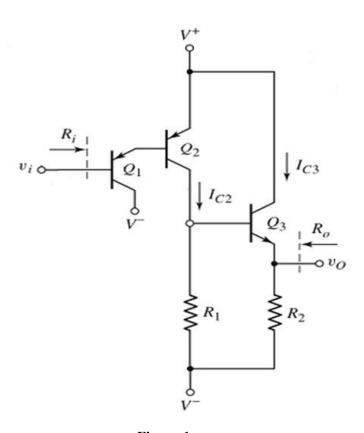


Figure 1

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$egin{array}{c} R_o \ Z \ R_{ m c2} \end{array}$	= $R_2 \parallel [(r_{\pi 3} + \mathbf{Z}) / (1 + \beta)]$ = $R_1 \parallel R_{c2}$ = $r_{O2} = V_A / I_{C2}$ = $(120 \text{ V})/(0.3 \text{ mA}) = 400 \text{ k}\Omega$	[1.5] [1] [2] [1]
$\begin{bmatrix} Z \\ r_{\pi 3} \\ R_O \end{bmatrix}$	= $(55 \text{ k}\Omega) \parallel (400 \text{ k}\Omega) = 48.351 \text{ k}\Omega$ = $(\beta V_T) / I_{C3} = (100 \text{ x} 0.026) / 1\text{ m} = 2.6 \text{ k}\Omega$ = $(8 \text{ k}\Omega) \parallel [(2.6 \text{ k}\Omega + 48.351 \text{ k}\Omega) / (1 + 100)]$ = 474.55Ω	[1] [2] [1] [0.5]

$$i_C = I_S e^{v_{BE}/V_T}$$
; npn
 $i_C = I_S e^{v_{EB}/V_T}$; pnp
 $i_C = \alpha i_E = \beta i_B$
 $i_E = i_B + i_C$
 $\alpha = \frac{\beta}{\beta + 1}$

$$\beta = g_m r_{\pi}$$

$$r_{\pi} = \frac{\beta V_T}{I_{CQ}}$$

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

$$r = \frac{V_A}{I_{CQ}}$$

$$V_T = 26 \,\mathrm{mV}$$

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EEEB273 - Quiz 5

SEMESTER 1, ACADEMIC YEAR 2016/2017

Date: 15 August 2016 Time: 15 minutes

Question:

Study the simple output stage circuit shown in Figure 1 carefully. Let $R_1 = 45 \text{ k}\Omega$, $R_2 = 10 \text{ k}\Omega$, $I_{C2} = 0.6 \text{ mA}$, and $I_{C3} = 1 \text{ mA}$. The transistor parameters are: $\beta = 100$ and $V_A = 120 \text{ V}$. Neglect base currents.

Determine the output resistance (R_0) of the emitter follower Q_3 .

[10 marks]

Write your answer using pen with proper Units for all the parameters. Show clearly all formula used in finding the solution.

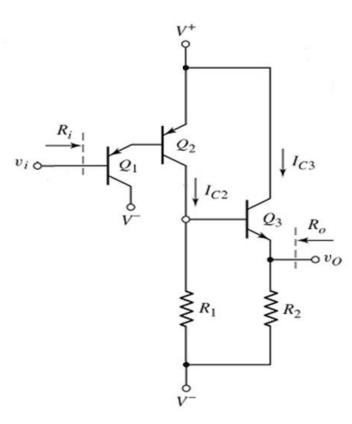


	Figure 1	
R _O Z R _{c2}	= $R_2 \parallel [(r_{\pi 3} + \mathbf{Z}) / (1 + \beta)]$ = $R_1 \parallel R_{c2}$ = $r_{O2} = V_A / I_{C2}$ = $(120 \text{ V})/(0.6 \text{ mA}) = 200 \text{ k}\Omega$	[1.5] [1] [2] [1]
Z $r_{\pi 3}$ R_O	= $(45 \text{ k}\Omega) \parallel (200 \text{ k}\Omega) = 36.735 \text{ k}\Omega$ = $(\beta V_T) / I_{C3} = (100 \text{ x} 0.026) / 1\text{m} = 2.6 \text{ k}\Omega$ = $(10 \text{ k}\Omega) \parallel [(2.6 \text{ k}\Omega + 36.735 \text{ k}\Omega) / (1 + 100)]$ = 374.85Ω	[1] [2] [1] [0.5]

$$i_C = I_S e^{v_{BE}/V_T}$$
; npn
 $i_C = I_S e^{v_{EB}/V_T}$; pnp
 $i_C = \alpha i_E = \beta i_B$
 $i_E = i_B + i_C$
 $\alpha = \frac{\beta}{\beta + 1}$

$$\beta = g_m r_{\pi}$$

$$r_{\pi} = \frac{\beta V_T}{I_{CQ}}$$

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

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

$$V_T = 26 \,\mathrm{mV}$$