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

EEEB273 - Quiz 5 [Question Set 1]
SEMESTER 1, ACADEMIC YEAR 2011/2012
Date: 18 July 2011

Question:

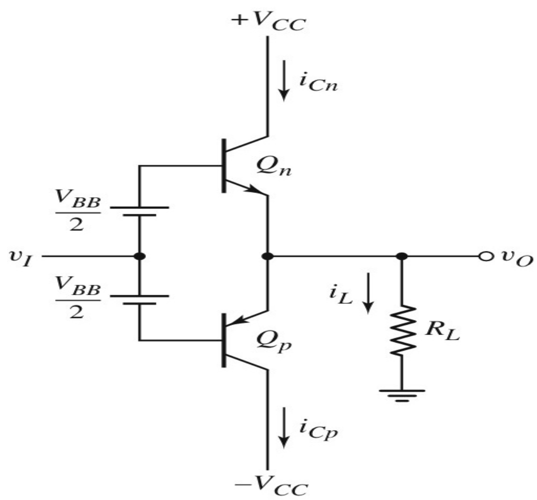

Figure 1

For the **class AB** output stage in **Figure 1**, given that $\boldsymbol{V_{CC}}$ **= 12 V** and $\boldsymbol{V_{BB}}$ **= 1.44 V**. $\boldsymbol{R_L}$ **= 1 kΩ**. The reverse-bias saturation current for the transistors, $\boldsymbol{I_S = 2.2 \times 10^{-15}}$ **A**. Assume $\boldsymbol{\beta >> 1}$.

For the output voltage $\boldsymbol{v_O}$ **= -9.5 V**:

(i) Determine $\boldsymbol{i_L}$, $\boldsymbol{i_{Cn}}$, and $\boldsymbol{i_{Cp}}$. [8 marks]
(ii) Find the power dissipated in transistor $\boldsymbol{Q_n}$. [2 marks]

Answer: (You may continue your answer in the next page)

$v_O = -9.5\text{ V} = i_L R_L$
$i_L = v_O / R_L = (-9.5\text{ V})/(1\text{ k}\Omega) = -9.5\text{ mA}$ [1]

Therefore, Q_p is conducting and Q_n is OFF.
$i_L \approx i_{Cp} = I_S \exp(V_{EBP}/V_T)$ [1]
$V_{EBP} = V_T \ln(i_{Cp}/I_S) = 26\text{m} \ln(9.5\text{m}/2.2\text{x}10^{-15}) = 0.7564\text{ V}$ [1.5]

$V_{BEN} = V_{BB} - V_{EBP} = 1.44 - 0.7564 = 0.6838\text{ V}$ [2]
$i_{Cn} = I_S \exp(V_{BEN}/V_T) = 2.2\text{x}10^{-15}\exp(0.6838/26\text{m}) = 575.9\ \mu\text{A}$ [1]

$i_{Cn} = i_{Cp} + i_L$ [0.5]
Actual value of $i_{Cp} = i_{Cn} - i_L = 575.9\mu - (-9.5\text{m}) = 10.0759\text{ mA}$ [1]

$P_{Qn} = i_{Cn} V_{CEn}$ [0.5]
$V_{CEn} = +V_{CC} - v_O = +12 - (-9.5) = 21.5\text{ V}$ [1]
$P_{Qn} = (575.9\ \mu\text{A})(21.5\text{ V}) = 12.38\text{ mW}$ [0.5]

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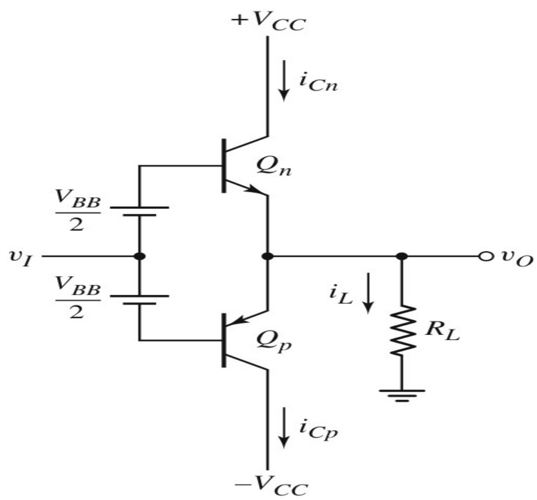

Figure 1

For the **class AB** output stage in **Figure 1**, given that $\boldsymbol{V_{CC} = 12}$ **V** and $\boldsymbol{V_{BB} = 1.42}$ **V**. $\boldsymbol{R_L = 1}$ **kΩ**. The reverse-bias saturation current for the transistors, $\boldsymbol{I_S = 2.4 \times 10^{-15}}$**A**. Assume $\boldsymbol{\beta >> 1}$.

For the output voltage $\boldsymbol{v_O = -10.5}$ **V**:

(iii)Determine $\boldsymbol{i_L}$, $\boldsymbol{i_{Cn}}$, and $\boldsymbol{i_{Cp}}$. [8 marks]

(iv)Find the power dissipated in transistor $\boldsymbol{Q_n}$. [2 marks]

Answer: (You may continue your answer in the next page)

$v_O = -10.5\text{ V} = i_L R_L$

$i_L = v_O/R_L = (-10.5\text{ V})/(1\text{ k}\Omega) = -10.5\text{ mA}$ **[1]**

Therefore, Q_p is conducting and Q_n is OFF.

$i_L \approx i_{Cp} = I_S \exp(V_{EBP}/V_T)$ **[1]**

$V_{EBP} = V_T \ln(i_{Cp}/I_S) = 26\text{m} \ln(10.5\text{m}/2.4\text{x}10^{-15}) = 0.7568\text{ V}$ **[1.5]**

$V_{BEN} = V_{BB} - V_{EBP} = 1.42 - 0.7568 = 0.6632\text{ V}$ **[2]**

$i_{Cn} = I_S \exp(V_{BEN}/V_T) = 2.4\text{x}10^{-15}\exp(0.6632/26\text{m}) = 287.3\ \mu\text{A}$ **[1]**

$i_{Cn} = i_{Cp} + i_L$ **[0.5]**

Actual value of $i_{Cp} = i_{Cn} - i_L = 287.3\mu - (-10.5\text{m}) = 10.7873\text{ mA}$ **[1]**

$P_{Qn} = i_{Cn} V_{CEn}$ **[0.5]**

$V_{CEn} = +V_{CC} - v_O = +12 - (-10.5) = 22.5\text{ V}$ **[1]**

$P_{Qn} = (283.7\ \mu\text{A})(22.5\text{ V}) = 6.47\text{ mW}$ **[0.5]**

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EEEB273 - Quiz 5 [Question Set 2]
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Date: 18 July 2011

Question:

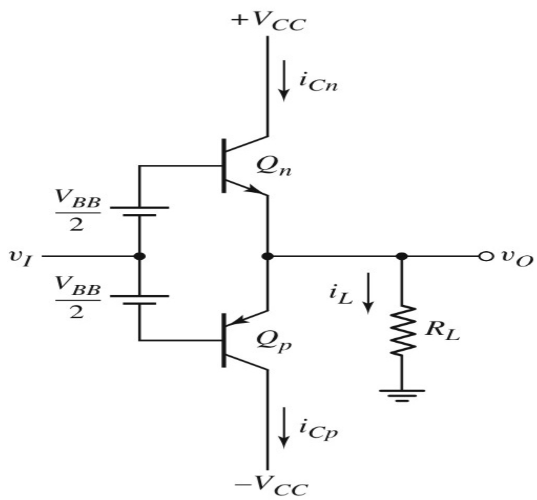

Figure 1

For the **class AB** output stage in **Figure 1**, given that V_{CC} **= 14 V** and V_{BB} **= 1.46 V**. R_L **= 1 kΩ**. The reverse-bias saturation current for the transistors, $I_S = 2.4 \times 10^{-15}$ **A**. Assume $\beta >> 1$.

For the output voltage v_O **= -10 V**:

(v) Determine i_L, i_{Cn}, and i_{Cp}. [8 marks]

(vi) Find the power dissipated in transistor Q_n. [2 marks]

Answer: (You may continue your answer in the next page)

$v_O = -10\text{ V} = i_L R_L$

$i_L = v_O / R_L = (-10\text{ V})/(1\text{ k}\Omega) = -10\text{ mA}$ [1]

Therefore, Q_p is conducting and Q_n is OFF.

$i_L \approx i_{Cp} = I_S \exp(V_{EBP}/V_T)$ [1]

$V_{EBP} = V_T \ln(i_{Cp} / I_S) = 26\text{m} \ln(10\text{m} / 2.4\text{x}10^{-15}) = 0.7555\text{ V}$ [1.5]

$V_{BEN} = V_{BB} - V_{EBP} = 1.46 - 0.7555 = 0.7045\text{ V}$ [2]

$i_{Cn} = I_S \exp(V_{BEN}/V_T) = 2.4\text{x}10^{-15} \exp(0.7045/26\text{m}) = 1405.2\ \mu\text{A}$ [1]

$i_{Cn} = i_{Cp} + i_L$ [0.5]

Actual value of $i_{Cp} = i_{Cn} - i_L = 1405.2\mu - (-10\text{m}) = 11.4052\text{ mA}$ [1]

$P_{Qn} = i_{Cn} V_{CEn}$ [0.5]

$V_{CEn} = +V_{CC} - v_O = +14 - (-10) = 24\text{ V}$ [1]

$P_{Qn} = (1405.2\ \mu\text{A})(24\text{ V}) = 33.72\text{ mW}$ [0.5]

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EEEB273 - Quiz 5 [Question Set 3]
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Question:

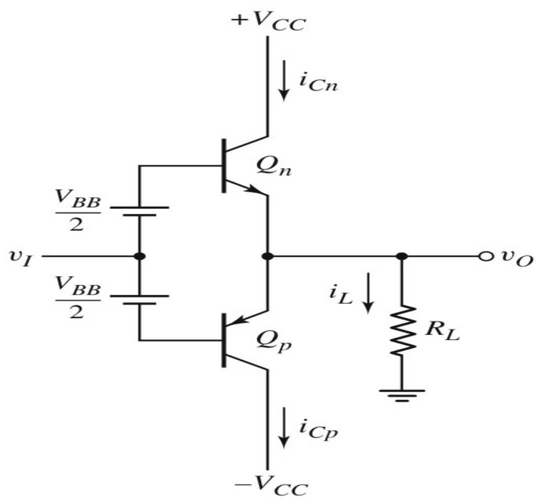

Figure 1

For the **class AB** output stage in **Figure 1**, given that V_{CC} **= 12 V** and V_{BB} **= 1.4 V**. R_L **= 1 kΩ**. The reverse-bias saturation current for the transistors, $I_S = 2.4 \times 10^{-15}$ **A**. Assume $\beta >> 1$.

For the output voltage v_O **= -8.5 V**:

(vii) Determine i_L, i_{Cn}, and i_{Cp}. [8 marks]

(viii) Find the power dissipated in transistor Q_n. [2 marks]

Answer: (You may continue your answer in the next page)

$v_O = -8.5 \text{ V} = i_L R_L$

$i_L = v_O / R_L = (-8.5 \text{ V})/(1 \text{ k}\Omega) = -8.5 \text{ mA}$ **[1]**

Therefore, Q_p is conducting and Q_n is OFF.

$i_L \approx i_{Cp} = I_S \exp(V_{EBP}/V_T)$ **[1]**

$V_{EBP} = V_T \ln(i_{Cp} / I_S) = 26\text{m} \ln(8.5\text{m} / 2.4\text{x}10^{-15}) = 0.7513 \text{ V}$ **[1.5]**

$V_{BEN} = V_{BB} - V_{EBP} = 1.4 - 0.7513 = 0.6487 \text{ V}$ **[2]**

$i_{Cn} = I_S \exp(V_{BEN}/V_T) = 2.4\text{x}10^{-15}\exp(0.6487/26\text{m}) = 164.5 \text{ µA}$ **[1]**

$i_{Cn} = i_{Cp} + i_L$ **[0.5]**

Actual value of $i_{Cp} = i_{Cn} - i_L = 164.5\mu - (-8.5\text{m}) = 8.6645 \text{ mA}$ **[1]**

$P_{Qn} = i_{Cn} V_{CEn}$ **[0.5]**

$V_{CEn} = +V_{CC} - v_O = +12 - (-8.5) = 20.5 \text{ V}$ **[1]**

$P_{Qn} = (164.5 \text{ µA})(20.5 \text{ V}) = 3.37 \text{ mW}$ **[0.5]**

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EEEB273 - Quiz 5 [Question Set 4]
SEMESTER 1, ACADEMIC YEAR 2011/2012
Date: 18 July 2011

Question:

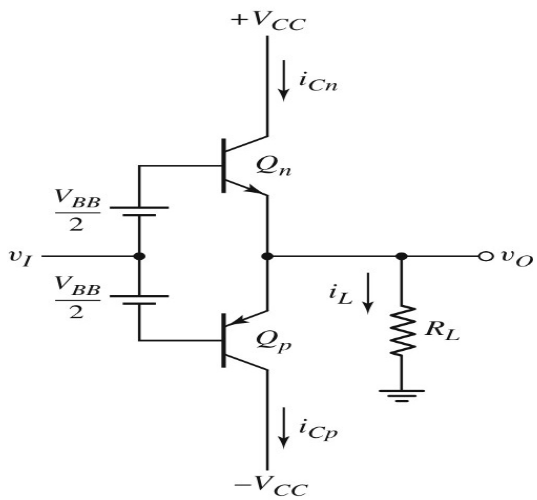

Figure 1

For the **class AB** output stage in **Figure 1**, given that V_{CC} **= 12.5 V** and V_{BB} **= 1.48 V**. R_L **= 1 kΩ**. The reverse-bias saturation current for the transistors, $I_S = 2.4 \times 10^{-15}$ **A**. Assume $\beta >> 1$.

For the output voltage v_O **= -9.5 V**:

(ix) Determine i_L, i_{Cn}, and i_{Cp}. [8 marks]

(x) Find the power dissipated in transistor Q_n. [2 marks]

Answer: (You may continue your answer in the next page)

$v_O = -9.5\text{ V} = i_L R_L$

$i_L = v_O / R_L = (-9.5\text{ V})/(1\text{ k}\Omega) = -9.5\text{ mA}$ [1]

Therefore, Q_p is conducting and Q_n is OFF.

$i_L \approx i_{Cp} = I_S \exp(V_{EBP}/V_T)$ [1]

$V_{EBP} = V_T \ln(i_{Cp}/I_S) = 26\text{m} \ln(9.5\text{m}/2.4\text{x}10^{-15}) = 0.7542\text{ V}$ [1.5]

$V_{BEN} = V_{BB} - V_{EBP} = 1.48 - 0.7542 = 0.7258\text{ V}$ [2]

$i_{Cn} = I_S \exp(V_{BEN}/V_T) = 2.4\text{x}10^{-15}\exp(0.7258/26\text{m}) = 3192.1\ \mu\text{A}$ [1]

$i_{Cn} = i_{Cp} + i_L$ [0.5]

Actual value of $i_{Cp} = i_{Cn} - i_L = 3192.1\mu - (-9.5\text{m}) = 12.6921\text{ mA}$ [1]

$P_{Qn} = i_{Cn} V_{CEn}$ [0.5]

$V_{CEn} = +V_{CC} - v_O = +12.5 - (-9.5) = 22\text{ V}$ [1]

$P_{Qn} = (3192.1\ \mu\text{A})(22\text{ V}) = 70.23\text{ mW}$ [0.5]