MECE 246 2017-2018 Spring
06-04-2018

MECE 246 Midterm

(Q1)

$I_1 + (-I_B) = I_2 \rightarrow I_2 + I_B = I_1$ (3)

$\frac{V_B}{R_2} + I_B = \frac{V_{CC} - V_B}{R_1}$ (8) (3)

$V_B - V_E = 0.7$ $\quad I_E = \frac{V_E}{R_E} = \frac{V_E}{10600}$ (1) $\quad I_B = \frac{I_E}{\beta + 1} = \frac{V_E}{10600 \times 100} = \frac{V_B - 0.7}{10600 \times 100}$

$\frac{V_B}{6 \times 10^6} + I_B = \frac{12 - V_B}{10^6}$ (3) $\quad \frac{V_B}{6 \times 10^6} + \frac{V_B - 0.7}{10600 \times 100} = \frac{12 - V_B}{10^6}$ (8)

$\frac{V_B}{6} + \frac{V_B - 0.7}{1.06} = \frac{12 - V_B}{1}$ (8)

$1.06 V_B + 6 V_B - 4.2 = 12 \times 6.36 - 6.36 V_B$

$13.36 V_B = 12 \times 6.36 + 4.2$

(1) $V_B = 6$ Volt $\quad I_B = \frac{V_B - 0.7}{10600 \times 100} = \frac{5.3}{10600 \times 100} = 5\,\mu A$ (1) $\quad I_E = \frac{5.3}{10600} = 500\,\mu A = 0.5\,mA$

(1) $V_E = 5.3$ Volt

(1) $I_C = 495\,\mu A = 0.495\,mA$
$= 495 \times 10^{-6}$ A

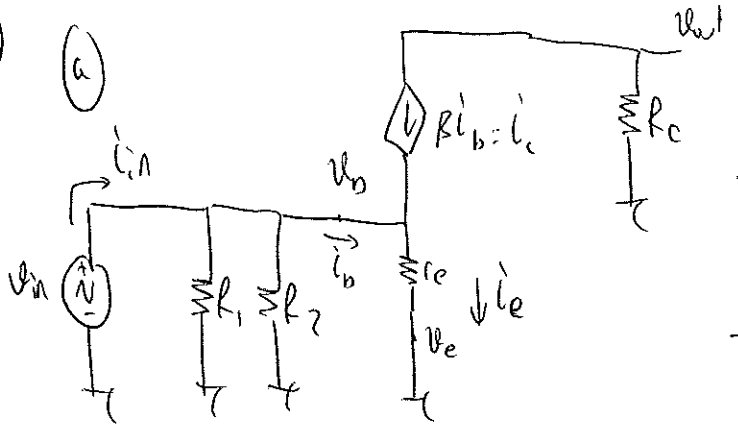
$V_C = V_{CC} - R_C I_C$ (4)
$= 12 - \frac{2000}{495} \times 10^6 \times 495 \times 10^{-6}$

$V_C = 10$ Volt (1)

Gides 5

(Q2)

(a)



→ (10 puan)

→ her hata için 2 puan gidecek

(b) $i_e = \frac{v_b}{r_e}$ (5) $\quad i_b = \frac{v_b}{(\beta+1) r_e}$ (5)

her hata için 2 puan gidecek

(2) $v_{out} = -\beta i_b R_C$ (15 puan)

(3) $\frac{v_{out}}{v_{in}} = \frac{-\beta i_b R_C}{(\beta+1) r_e i_b} = \frac{-\beta}{\beta+1} \frac{R_C}{r_e}$

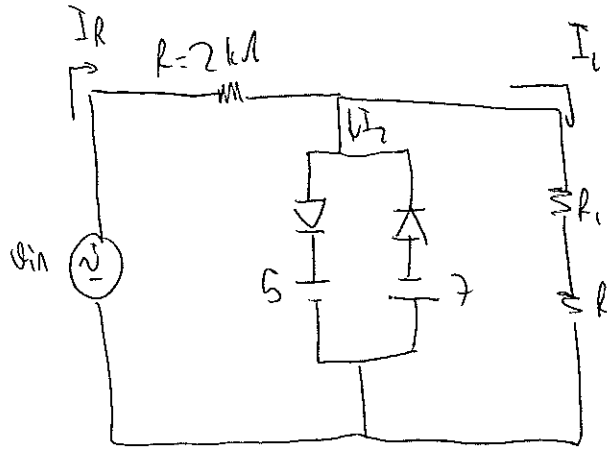
(c) $R_{in} = \frac{v_{in}}{i_{in}} \Rightarrow$ $\quad i_{in} = \frac{v_{in}}{R_1} + \frac{v_{in}}{R_2} + \frac{v_{in}}{r_e(\beta+1)}$ (10)

$i_{in} = i_{R_1} + i_{R_2} + i_b$ (3) → (15 puan)

$\frac{v_{in}}{i_{in}} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{r_e(\beta+1)}} = [R_1 // R_2 // r_e(\beta+1)]$ (2)

her hata için 2 puan gidecek

Q3



$$V_{out} = \frac{V_K}{7000} \times 1000$$

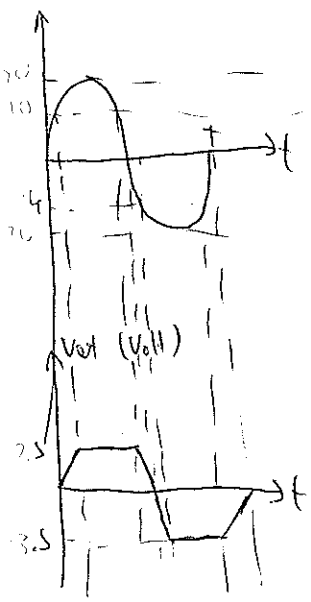
$$V_{out} = \frac{V_K}{2}$$

When $V_K = 5$ Volt and $I_Z = 0$

$$\frac{V_{in} - V_K}{R} = \frac{V_K}{R_1 + R_2} \qquad \frac{V_{in} - 5}{2000} = \frac{5}{7000} \Rightarrow V_{in} = 10 \text{ Volt}$$

When $V_K = -7$ Volt and $I_Z = 0$

$$\frac{V_{in} - V_K}{R} = \frac{V_K}{R_1 + R_2} \qquad \frac{V_{in} - (-7)}{2000} = \frac{(-7)}{7000} \Rightarrow V_{in} = -14 \text{ Volt}$$



if $-14 < V_{in} < 10$ $\quad I_R = I_L = \frac{V_{in}}{R + R_1 + R_2} = \frac{V_{in}}{4000}$

$$V_{out} = I_L R_1 = \frac{V_{in}}{4000} \times 1000 = \frac{V_{in}}{4}$$

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if $10 < V_{in}$; $V_K = 5$ Volt ; $V_{out} = 2.5$ Volt

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if $V_{in} < -14$; $V_K = -7$ Volt ; $V_{out} = -3.5$ volt