

Hi 94
 Au 35
 low 4

Gray Chang
 DT
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EECS 105
 Spring 1975

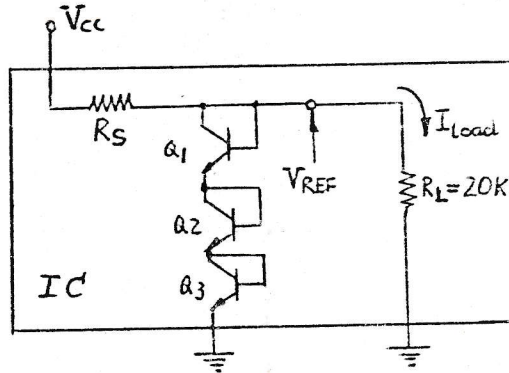
MIDTERM EXAM

Answer all questions in the space provided.
 Time allowed: 50 Minutes
 Total points: 100

OPEN BOOK EXAM

1.) (25 points)

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Assume: $\beta \rightarrow \infty$
 $V_T = 26mV$

Above figure shows an IC- voltage reference supply produced by three transistors.

a) If $V_{cc} = 10V$ nominal, and the standing current through Q_1 to Q_3 is made 5 times the load current I_{load} , what is the saturation current I_s for each device if $V_{REF} = 2V$ nominal? What is the value of R_s ?

$I_{load} = \frac{2}{20K} = 0.1 mA$ $I_Q = 0.5 mA$ $I_{R_s} = \frac{10-2}{R_s} = 0.6 mA$ $R_s = 13.3 K$ ✓
 $I_Q = I_s e^{\frac{V}{V_T}}$ $\frac{0.5 mA}{e^{\frac{0.666}{0.026}}} = I_s = \frac{.5}{1.33 \times 10^{11}} = 3.76 \times 10^{-13} mA$

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b) If V_{cc} changes by $\pm 5V$ from its nominal value, by how much does V_{REF} change approximately?

$V_{REF} \approx \text{constant}$

LIKE 3 DIODES $I_{D(5)} \Rightarrow \frac{15-2}{13.3K} \Rightarrow 1\frac{2}{3}$ increase
 FIND NEW CURRENT THRU DIODES, USE $\Delta V = 3 \ln(\quad)$

$V_T \ln \frac{I_Q}{I_s} = V$
 $V_T (\ln I_{Q_{new}} - \ln I_s) = V_{new}$ $V_T \ln I_{Q_{new}} - V_T \ln I_s = V_{new}$
 $V_T \ln \frac{I_{Q_{new}}}{I_{Q_{old}}} = \Delta V = 0.12$ $-1 - \dots - 0.22$
 $0.075 V$
 $I_{R_s \text{ before}} = \frac{10-2}{13.3K} = 0.6 mA$
 $I_{R_s \text{ after}} = \frac{8 \pm 5}{13.3K} = 1 mA$