EE232-INTRODUCTION TO ELECTRONICS-FALL 2009
EXERCISE-BJT2

P1 In the amplifier circuit shown in Figure-1, $|V_{BE}| \cong 0.6V$, $V_T \cong 26mV$ and $\beta_F = 200$ are given for the transistors.
a) V_O is required "0V" in DC case when Vi=0V.
Find R_{C3}. (10Points)

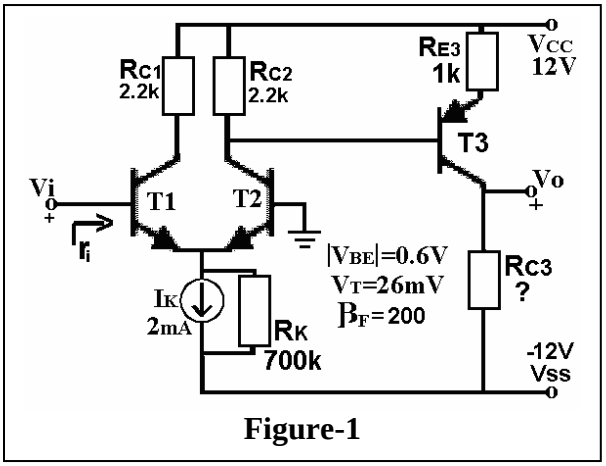


Figure-1

A-1a
Vo=0V has been given for Vi=0V.
From the circuit topology;

$I_{RC2} = I_{RC1} \cong \frac{I_K}{2} = 1mA$ **(I_{RK} can be neglected)**

Then,

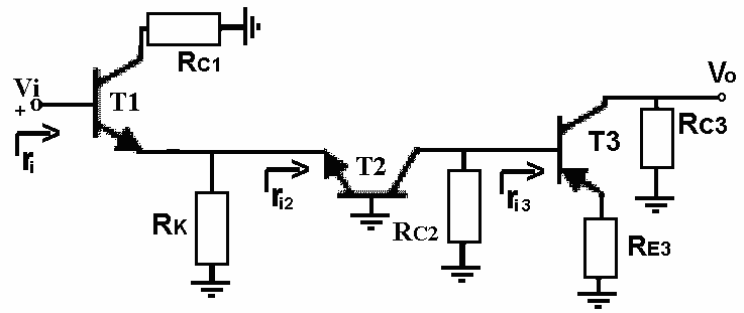
$I_{RC2} x R_{C2} = V_{RE3} + V_{EB} = I_{E3} x R_{E3} + V_{EB}$
$1mx2.2k = I_{E3} x1k + 0.6V \Rightarrow I_{E3} = 1.6mA \cong I_{C3}$

$V_{RC3} = I_{C3} x R_{C3} = V_o - V_{ss} = 0 - (-12V) = 12V$
$R_{C3} = 7.5k\Omega$

R_{C3}=7.5k is obtained.

b) Find ac gain (νo/νi) of the circuit.(10Points)

A-1b



ac case of the circuit

T1: emitter-follower: $\frac{ve_1}{vi} = \frac{gm_1 R_{e1}}{1 + gm_1 R_{e1}} = \frac{gm_1 (R_K // r_{i2})}{1 + (R_K // r_{i2})}$ $\qquad ri_2 = \frac{1}{gm_2} + \frac{R_{b2}}{\beta_F} = \frac{1}{gm_2} + \frac{0}{\beta_F} = \frac{1}{gm_2}$

T2: common-base: $\frac{vc_2}{ve_2} = \frac{gm_2 R_{c2}}{1 + gm_2 \frac{R_{b2}}{\beta_F}} = \frac{gm_2 (R_{C2} // ri_3)}{1 + gm_2 \frac{0}{\beta_F}} = gm_2 (R_{C2} // ri_3)$

$ri_3 = \beta_F (\frac{1}{gm_3} + \mathrm{Re}_3) = \beta_F (\frac{1}{gm_3} + R_{E3})$

T3: common-emitter: $\frac{vc_3}{vb_3} = -\frac{gm_3 R_{c3}}{1+gm_3 R_{e3}} = -\frac{gm_3 R_{C3}}{1+gm_3 R_{E3}}$

$gm_1 = \frac{I_{C1}}{V_T}$ $gm_2 = \frac{I_{C2}}{V_T} = gm_1$ $gm_3 = \frac{I_{C3}}{V_T}$

$\frac{vo}{vi} = \frac{ve_1}{vi} x \frac{vc_2}{ve_2} x \frac{vc_3}{vb_3} = \frac{1}{2} x88x(-7.38) = -325$

c) Find CMRR of the circuit. (10Points)

A-1c

$CMRR = \frac{1}{2} + gmxR_{EE} = \frac{1}{2} + gm_1 xR_K = 0.5 + \frac{1}{25} 700k \cong 28000$