2013 AIC Final Exam Solution

1.

$Z_1=Z/(1+A)$

$Z_2=Z/(1+A^{-1})$

2.

(a)

$C_{in}=C_{GD}(1+g_mR_D)+C_{GS}=1010fF$

$C_{out}=C_{GD}(1+(g_mR_D)^{-1})+C_{DB}=10.025fF$

(b)

$W_{in}= 1/(R_{in}*C_{in})=9.901M$ rad/s

$W_{out}=1/(R_{out}*C_{out})=997.51M$ rad/s

(c)

$W_z=g_m/C_{GD}=400G$ rad/s

(d)

$R_S=100k\Omega$ as freq to infinity

3.

(a)

$Wp1=1/(R_{out}*C_L) =200M$ rad/s

(b)

$Wp2=g_m/C_E=100G$ rad/s

(c)

$Wz=2g_m/C_E=200G$ rad/s

(d)

Wz=2 Wp2

4.

(a)

Output refered noise = $4kT(g_{m1}+g_{m2})*(2/3)(r_{o1}||r_{o2})^2$

(b)

Input refered noise = $4kT*(2/3)*(g_{m1}+g_{m2})/(g_{m1})^2$

(c)

Increase g_{m1}/ decrease g_{m2}

5.

(a)

G_mR_F

(b)

$G_m/(1+ G_mR_F)$

(c)

$R_{in}(1+ G_mR_F)$

(d)

$R_{out}(1+ G_mR_F)$

(e)

Just illustrate the trade-off on G-BW between open-loop & closed-loop.

6.

視情況給分，有提到邊就給一分。

7.

Rout = A $gm_2\ ro_2$ Rs = $(gm_3\ ro_3)\ gm_2\ ro_2$ Rs = 2GΩ

8.

(a) $\beta = -1/R_F = -20\mu(\Omega^{-1})$

(b) $A_{,open} = (R_S||R_F) * - gm\ (R_D||R_F) = -2.22M$ (V/A)

(c) $A_{,closed} = A_{,open} / 1+\beta A_{,open} = -0.489$ (V/V)

9.

(a)正確電路架構 sense output 電壓

(b)negative feedback

10.

(a) SR = I_{SS}/C_L = 5M (V/S)

(b)SR = $I_{SS}/(C_1||C_2)$ = 75M(V/S)

(c)參考講義 9-45

(d)參考講義 9-46

11.

(a)

$W_{1st} = (R_{out1}*C_{out1})^{-1}$ = 200M(rad/s)

$W_{2nd} = (R_{out2}*C_{out2})^{-1}$ =1G(rad/s)

(b)

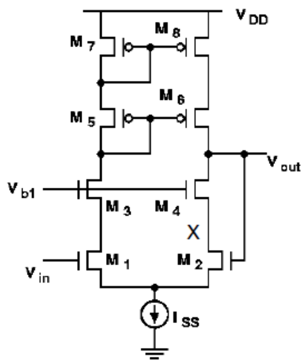
$C_{out1'}$ -> 1000x

$C_{out1'} = (1+A_{V2})Cc + C_{out1}$

Cc = 494.55fF

12.

(a)



$V_X = V_{b1} - V_{GS4}$ $\qquad V_{out} \le V_X + V_{TH2}$ $\qquad V_{out} \ge V_{b1} - V_{TH4}$

$$V_b - V_{TH4} \le V_{out} \le V_b - V_{GS4} + V_{TH2}$$

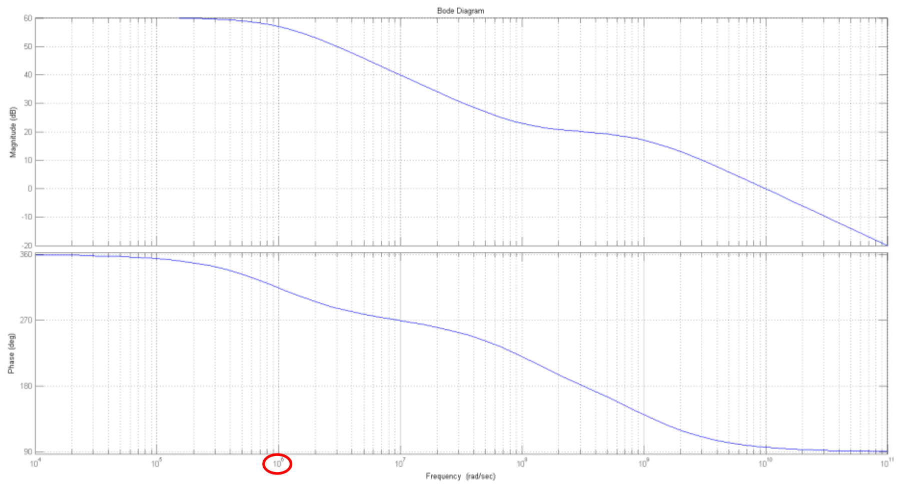
0.6(V) ≦Vout≦ 1(V)

(b)

Output swing = $V_{outmax} - V_{outmin}$ = 0.4(V)

13.

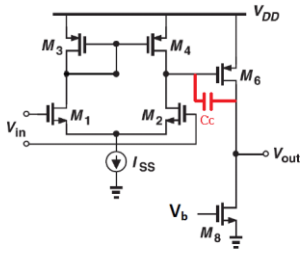
(a)pole zero 的 phase 掉 45 度, gain 分別是+20dB/dec 及-20dB/dec



(b) 10GHz

14.

(a)



Pole-splitting effect: Create a large capacitance, (1+A)Cc, at the input of the second stage amplifier to produce a dominant pole at low frequency. And increase the magnitude of the output pole by roughly a factor of $g_{m6}R_{out}$

(b)

RHP zero effect:

1) negative phase shift
2) slow down the drop of magnitude

solution:

1) Add a series resistor to eliminate the RHP zero or move the zero to higher frequency
2) Add a current buffer to break the feedthrough path

15.

(a)

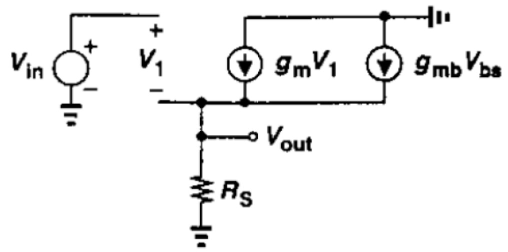
8

(b)

1.13V

16.

(a)



(b)

75/91=0.8241

17.

(a)

V_b=1V

V_{out}=0.4V

(b)

0.25um/2um

18.

(a) T

(b) T

(c) F, power is double

(d) F, width only

(e) F, inversely proportional to Vov because of 2I/Vov

(f) F, mobility is lower such that g_m is lower

(g) F, equal

(h) T

(i) F, except voltage swing

(j) F, impact ionization