NTHUEE

EE3235 Analog IC Analysis & Design - I 2019. Fall.

HW2

Due date : 2019. 10. 25 (Friday.) 23:59pm (upload to iLMS System)

First release : 2019. 10. 11

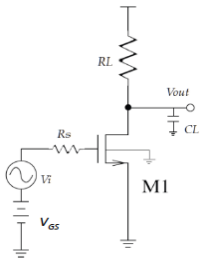
HW2 –Common Source

This homework is for you to design a **common source** stage. The results should include HSPICE simulations and hand calculations. The SPICE model is cic018.l. Please use the parameters from HSPICE simulation results for hand calculations.

Please note:

1. Please hand in your report using LMS.
2. Please note, **no delay allowed!!!**
3. **Please generate your report with *pdf* format (AIC_HW{X}_StudentID.pdf). At first page please add your student ID and name. Try to make the information "readable".** (Note: Don't use black color in background for your screen capture figures).
4. Please **hand in the spice code file (AIC_HW{X}_StudentID. sp)** with your report for each work. Do not include output file.
5. Please fill the results into HW2.xls. **(without this file, -20pt)**
6. Do not zip your whole package.

Please attach your spice code at the end of report.



Please follow the rules as before.

In the common source, please use V_{DD}=1.5V. The source impedance Rs is assumed 10Kohm and the loading capacitance C_L is 1.0pF.

(maximize the FoM$_1$)

(a) Please design the device size of M_1, load resistance R_L, and the bias voltage V_{GS}, to make the small signal voltage gain (v_{out}/v_i) is 15.

(b) We define the figure of merit (FOM_1) as "bandwidth (MHz) / bias current (μA)". Please try your best.

(determine the operation point)

(c) Please use .op command to print out its small signal parameters.

(d) Please hand-calculate the gain value using SPICE parameters from (b).

(e) Please sweep the gate DC voltage to draw its DC transfer curve. Please observe and mark the input-output linear transfer range around the selected V_{GS}.

(get the frequency response)

(f) Please plot the frequency response of this gain stage. And mark the poles and zeros on the curve. (please use .pz command to get poles and zeros, and compare with hand calculation).

(g) Please discuss your observations for best FOM_1.

(maximize the FoM_2)

(h) We will use the "maximal small-signal voltage gain" as the figure of merit (FOM_2). Please try your best.

(i) Please discuss your observations for best FOM_2.

For FoM_1 (fast speed and low power)	
M_1 Device Size (W/L)	
M_1 Bias Current (μA)	
M_1 Overdrive Voltage (mV)	
Load R (ohm)	
Small-Signal Voltage Gain (V/V)	15
Bandwidth (MHz)	
FoM_1 (max (bandwidth (MHz) / bias current (μA))	
For FoM_2 (highest gain)	
M_1 Device Size (W/L)	
M_1 Bias Current (μA)	
M_1 Overdrive Voltage (mV)	
Load R (ohm)	
Bandwidth (MHz)	
FoM_2 (max small-signal voltage gain (V/V))	