

# Microelectronic Circuits

## 8<sup>th</sup> Edition

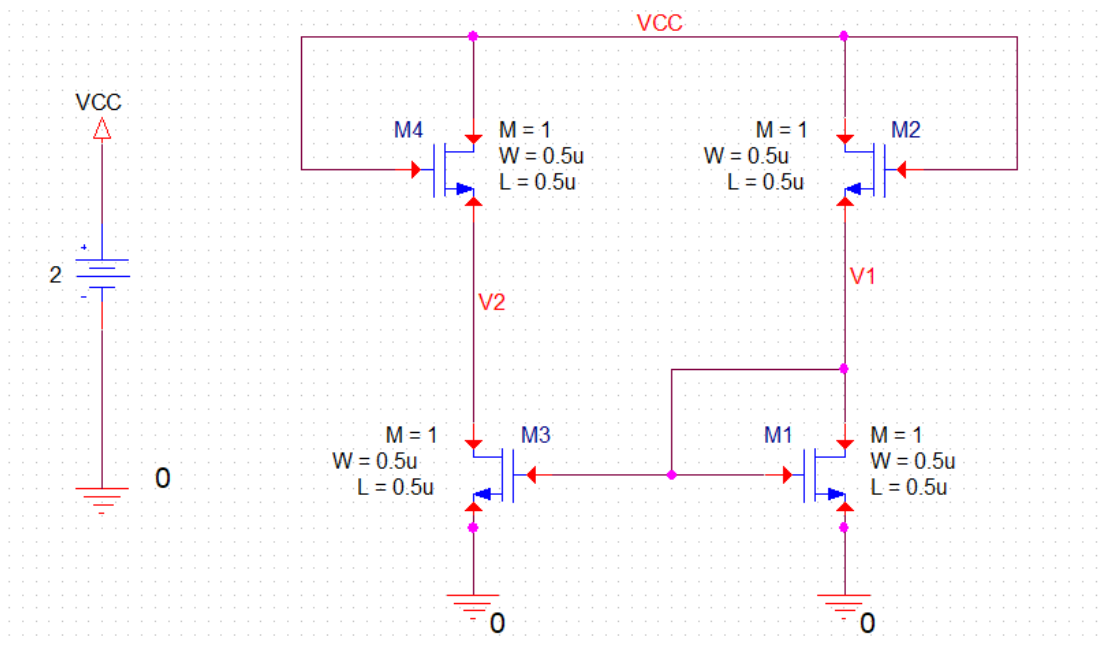
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*Spice Problems Solutions*  
*Chapter 5*

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*2019*

**Problem: 5.59**

1. The schematic for this problem is shown below



2. Run the netlist and calculate the operating point. Open the “output file” and find the node voltages, including V2.

NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE	NODE	VOLTAGE
( V1 )	1.0000	( V2 )	1.0000	( VCC )	2.0000		

3. Also find the current through the MOS M4, labeled  $I_2$  in the problem.

NAME	M4	M1	M2	M3
MODEL	NMOS0P5	NMOS0P5	NMOS0P5	NMOS0P5
ID	5.00E-05	5.00E-05	5.00E-05	5.00E-05
VGS	1.00E+00	1.00E+00	1.00E+00	1.00E+00
VDS	1.00E+00	1.00E+00	1.00E+00	1.00E+00
VBS	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VTH	5.00E-01	5.00E-01	5.00E-01	5.00E-01
VDSAT	5.00E-01	5.00E-01	5.00E-01	5.00E-01

4. Increase the width of M3 and M4 to 5 um and check the operating point again.

**Netlist:**

Copy the netlist given below and paste it into a text file and save it with \*.cir extension.

```

*****Problem: P5_59 *****
***** Main circuit begins here*****
V_sup      VCC 0 2
M4         VCC VCC V2 V2 NMOS0P5
+ L=0.5u
+ W=0.5u
+ M=1
M1         V1 V1 0 0 NMOS0P5
+ L=0.5u
+ W=0.5u
+ M=1
M2         VCC VCC V1 V1 NMOS0P5
+ L=0.5u
+ W=0.5u
+ M=1
M3         V2 V1 0 0 NMOS0P5
+ L=0.5u
+ W=0.5u
+ M=1
***** Main circuit ends here*****

***** NMOS model begins here *****
.model NMOS0P5 NMOS(Level=1 VTO=0.5 GAMMA=0.5 PHI=0.8
+          LD=0 WD=0 UO=1100 LAMBDA=0.00001 TOX=9.5E-9 PB=0.9 CJ=0.57E-3
+          CJSW=120E-12 MJ=0.5 MJSW=0.4 CGDO=0.4E-9 JS=10E-9 CGBO=0.38E-9
+          CGSO=0.4E-9)

***** NMOS model ends here *****

***** Analysis begins here*****
.OP
.END
***** Analysis ends here*****

```