

## **ECEN 325 Lab 10: Adding custom MOSFET models**

**Note: MULTISIM online does not work for Lab 10. Please use Virtual OAL([voal.tamu.edu](http://voal.tamu.edu)) option to connect to system on the campus and follow the same procedure listed below.**

## Adding User Database (CD4007N, CD4007P and 2N7000G Transistors)

- Download the file "UsrComp S ECEN.usr" to a folder
- On multisim, click on Options →global Options

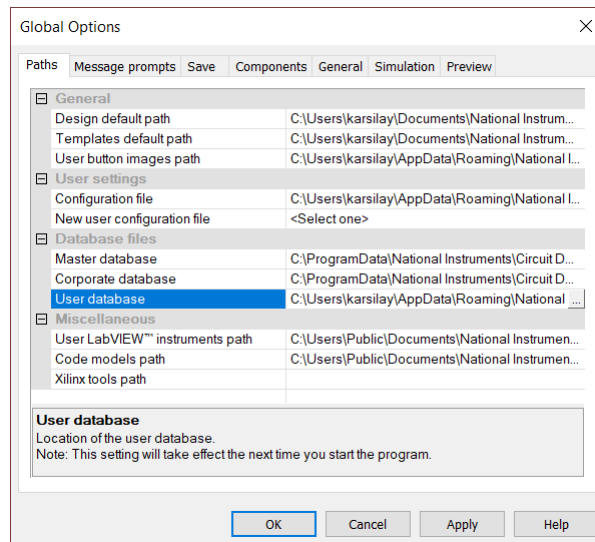
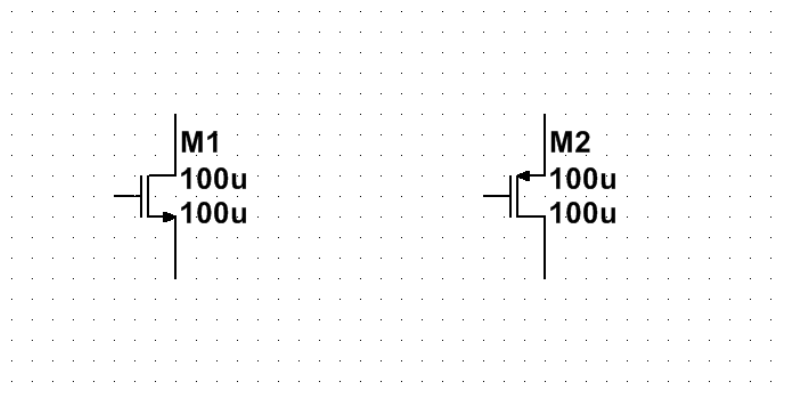


Figure 2: MultiSim global options

- In the Global Options window (see Fig.2), click on "User database", then click on ...
- Find the file "UsrComp\_S\_ECEN.usr", click on "Open", then "OK"
  - If it does not show up in the downloaded folder while looking to select, start typing Usr... and it will show up in the dropdown menu.
- restart the multisim for the upload to happen. It is the same procedure if you are working on Virtual OAL.
- while selecting the components, first select "User Database" on the top left corner and choose between 2N700G, and CD4007 based on the requirement.

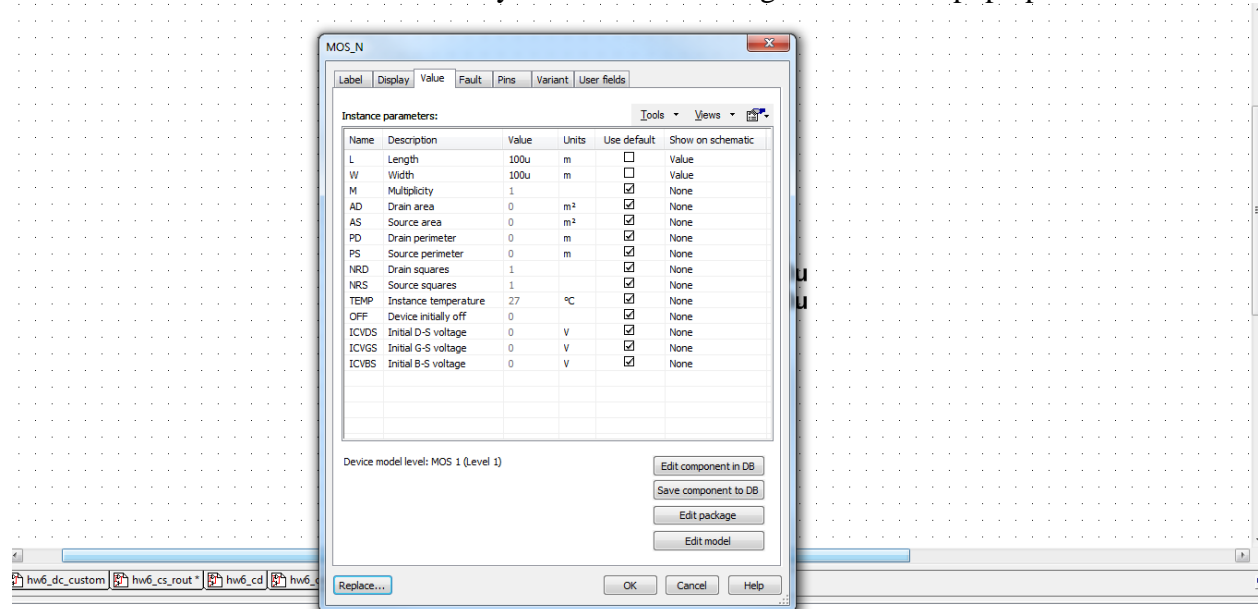
The custom MOSFET models allow the flexibility to edit key device parameters ( $V_{TN/P}$ ,  $KP_{N/P}$ ,  $\lambda$ ,  $W$ ,  $L$  etc...) and also provides a more standard symbol. These use of these models is required in matching between simulation and measurements for Labs 10 and 11. **For both the NMOS and PMOS models, the body terminal is shorted to the source.** Thus, it is only a 3-terminal model.



## Using Custom NMOS to Mimic 2N7000 Example

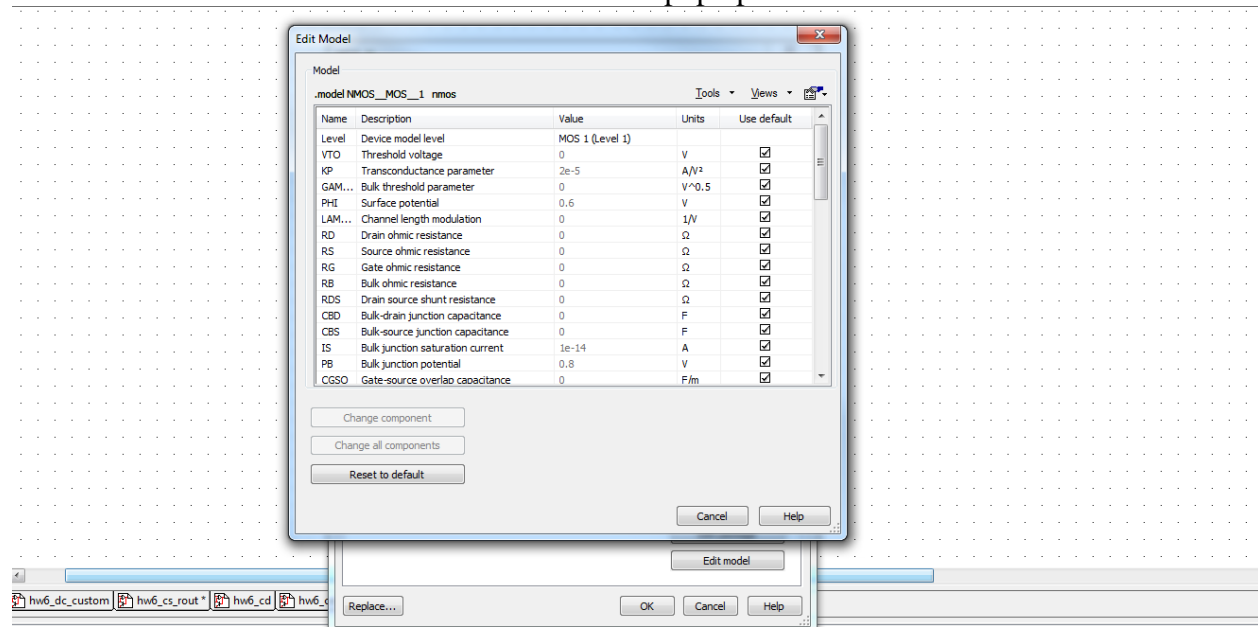
The default 2N7000 NMOS transistor model has a  $\beta=102\text{mA/V}^2$  and  $V_{TN}=2.0\text{V}$ . This can be emulated with the custom “MOS\_N” model with the following steps.

1. Place the MOS\_N model in your schematic.
2. Double click on the MOS\_N symbol. The following window will pop up.



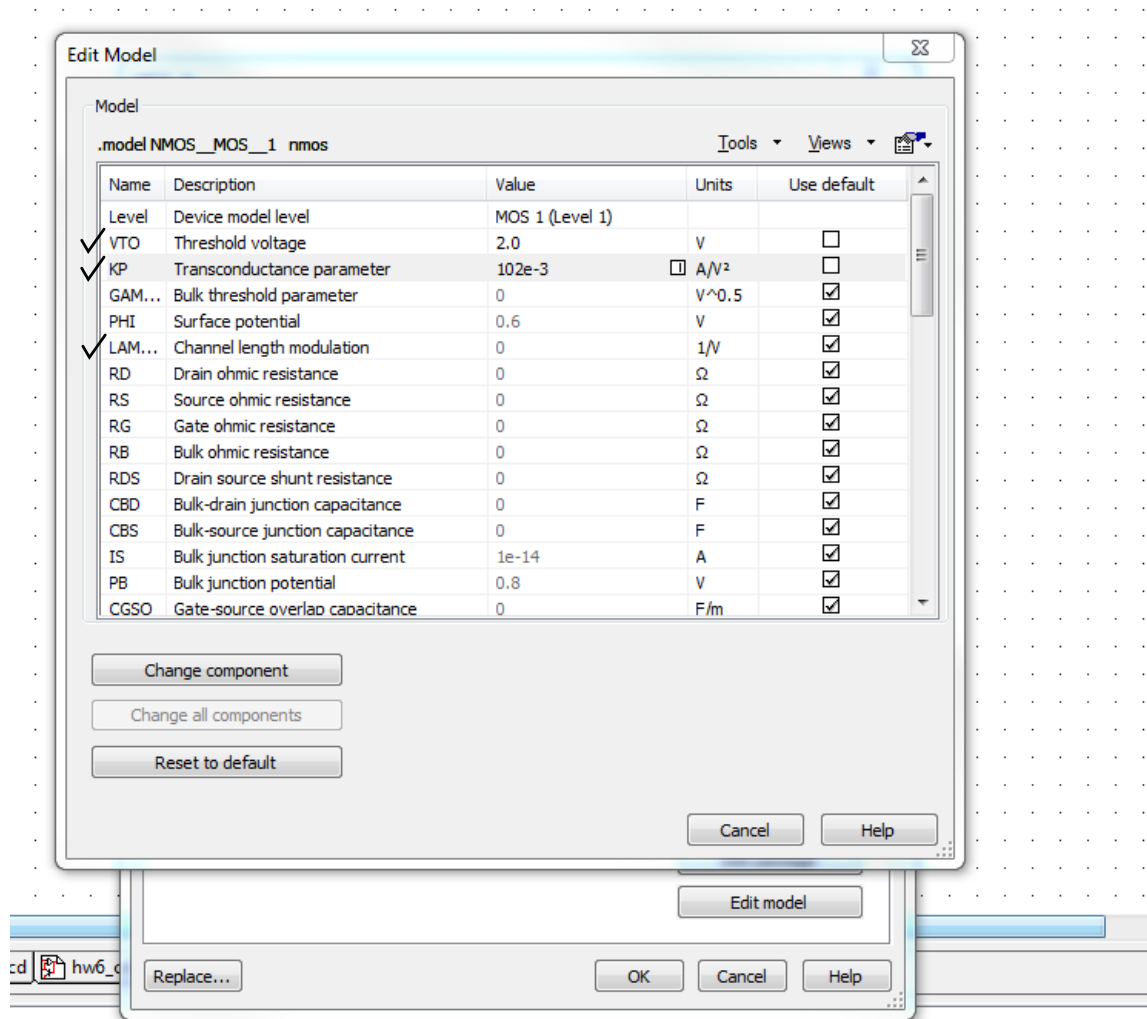
hw6\_cg\_rout - Friday, July 20, 2018, 6:13:25 PM -----  
mplemented, 0 error(s), 0 warning(s) =====

3. Click on Edit model. Another window will pop up.



hw6\_cg\_rout - Friday, July 20, 2018, 6:13:25 PM -----  
mplemented, 0 error(s), 0 warning(s) =====

- To edit the transistor parameters, unclick the “Use default” box and edit the value in the “Value” field. Below is an example to emulate the default 2N7000 NMOS transistor model, with  $\beta=102\text{mA/V}^2$  and  $V_{TN}=2.0\text{V}$ . As the custom model has a default  $W/L=1$ , only the  $KP_N$  value is edited to give a  $\beta=102\text{mA/V}^2$ . Also, change the value of Lambda to 0.1. This last step is to primarily bring in non-ideal behaviour.



- To commit these changes, click on “Change component”. The transistor parameter window will disappear. Then click on “OK” and you will be back in your main schematic.

You can use a similar procedure for the PMOS device and other MOSFET transistors.

**CD4007N: Beta = 1.11mA/V<sup>2</sup> and V<sub>th</sub> = 1.5V**

**CD4007P: Beta = 0.8 mA/V<sup>2</sup> and V<sub>th</sub> = -1.5V**