ECE 418 / 518 - Semiconductor Processing
Spring 2020
Simulation Assignment 2
Due at the beginning of class Wednesday May 27th

Question 1 [25 marks]:
   a) Using Athena and Atlas, simulate a p-type transistor and calculate output curves for this device. Your output curves should show characteristic linear and saturation regimes. To be p-type, your transistor should work under negative applied gate and drain voltages. You can use the code we developed in Lecture 19 as a template if you wish. Please include code and an image from TonyPlot in your answer.[5 marks]
   b) Calculate and display transfer curves for the n-type transistor we developed in Lecture 19. Recall from Lectures 13 and 14, that transfer curves are drain current (I_D) plotted as a function of gate voltage (V_G) for a constant drain voltage (V_D). Use a drain voltage of V_D = +1V and sweep between V_G = -1 V and V_G = 5 V in your answer, and display your data using a logarithmic y-axis. From these transfer curves, determine the on/off ratio of this device (the maximum drain current / minimum drain current). Using the same code, determine what the on/off ratio would be if the band gap of silicon was 0.82 eV. Please include code and images from TonyPlot in your answer.[10 marks]
   c) Use Athena to make an MOS capacitor that has an area of 1 μm², and an oxide thickness of roughly 50nm (±20nm is ok but note the actual value you get). Use a back contact in this structure. Use Atlas to calculate the capacitance of the oxide. Compare it to the expected value (e.g. using Lectures 7 and 8). You will need to know the dielectric constant of SiO₂ is ε_r = 3.9. Please include code and an image from TonyPlot in your answer.[10 marks]