ECE 320 - Homework #8

TTL Logic, MOSFET theory, MOSFET switch. Due Monday, October 19th

The following circuit implements a function using TTL logic

Assume

- $\beta = 100$ (NPN used correctly)
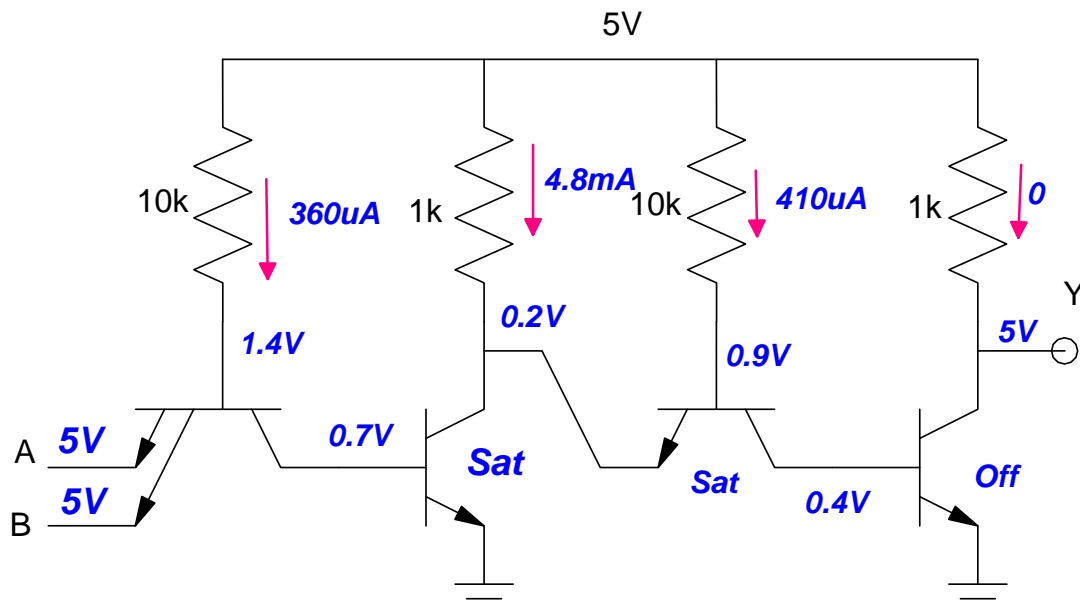- $\beta = 0.1$ (NPN used in reverse)

1) What is the logic for this circuit?

$Y = AB$

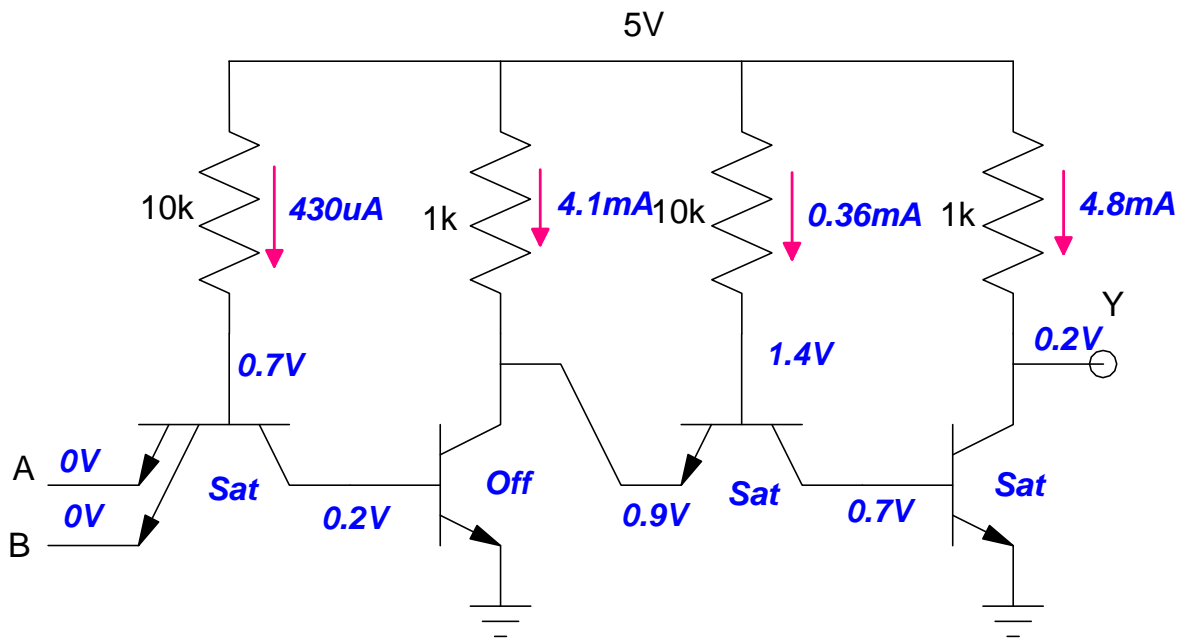The first stage is a NAND gate, the second stage is an inverter.

2) Determine the voltages and currents for

$A = B = 5V$

3) Determine the voltages and currents for

A = B = 0V

5V

10k   430uA   1k   4.1mA 10k   0.36mA   1k   4.8mA

Y

0.7V   1.4V   0.2V

A 0V   Off   Sat   Sat
    Sat
B 0V   0.2V   0.9V   0.7V

A 0V
B 0V

Assume the VI characteristics for a MOSFEt are as follows.

4) Label the Off / Saturated / Ohmic regions on this figure

5) Determine the constant kn for this MOSFET
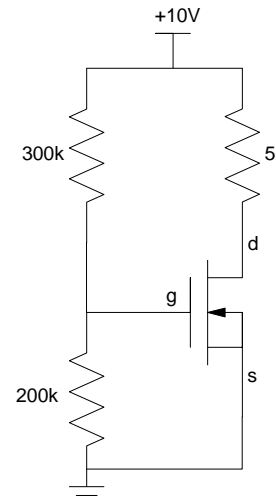
The current goes to zero at Vgs = 1.0V

    Vtn = 1.0V

Pick a point: Vgs = 5.5V, Ids = 200mA
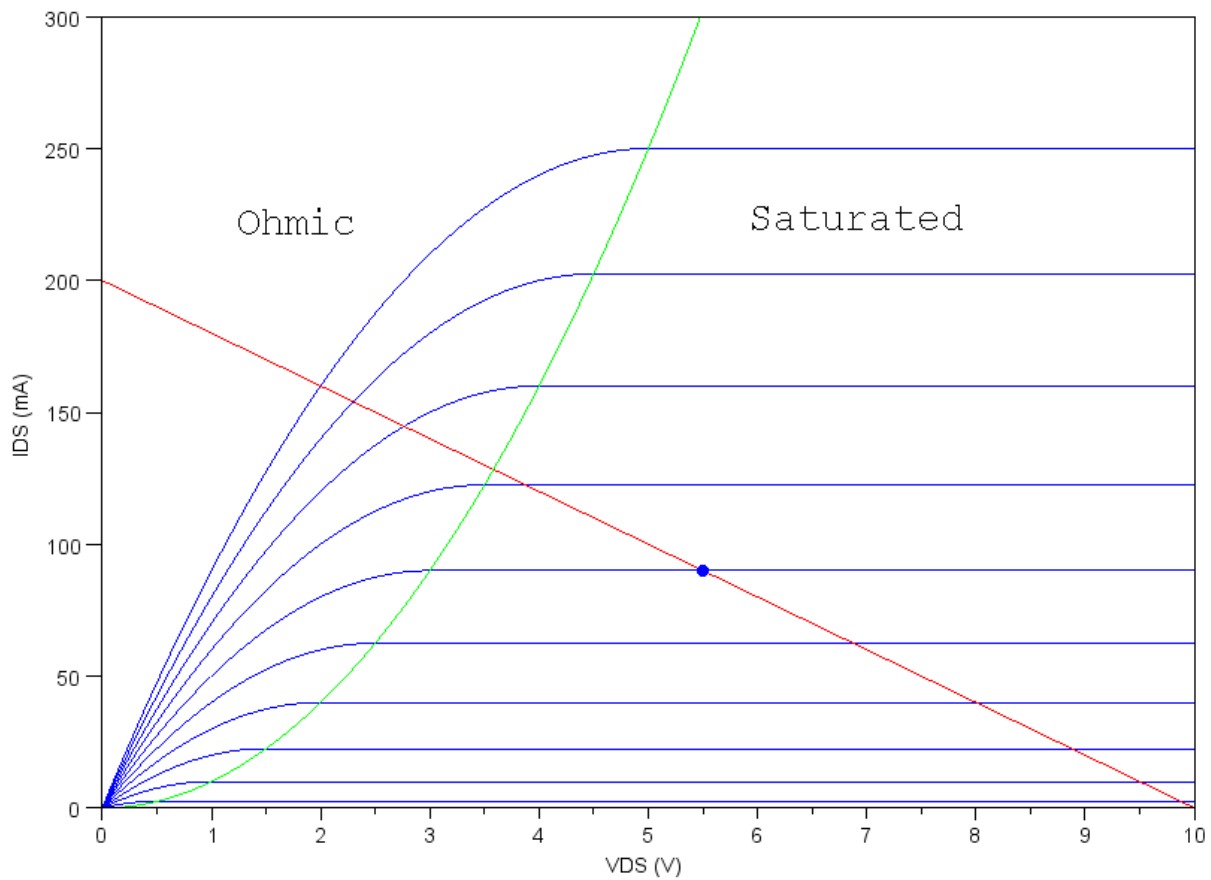
$$I_{DS} = \frac{k_n}{2}(V_{gs} - V_{tn})^2$$

$$0.2A = \frac{k_n}{2}(5.5V - 1.0V)^2$$

$$k_n = 0.02$$

6) Draw the load line and determine the operating point if connected as shown to the right:

    Vds = 5.5V, Ids = 90mA

Lab: (term project)

Take one section of your term project.

7) Requirements: Specify what your circuit is going to do
   * Inputs
   * Outputs
   * Relationship

8) Analysis. Calculations for votlages, currents, resistors, capacitors, etc

9) Test: Check you analysis in simulation.

10) Validation: Build your circuit and check that it meets the reqruiements.