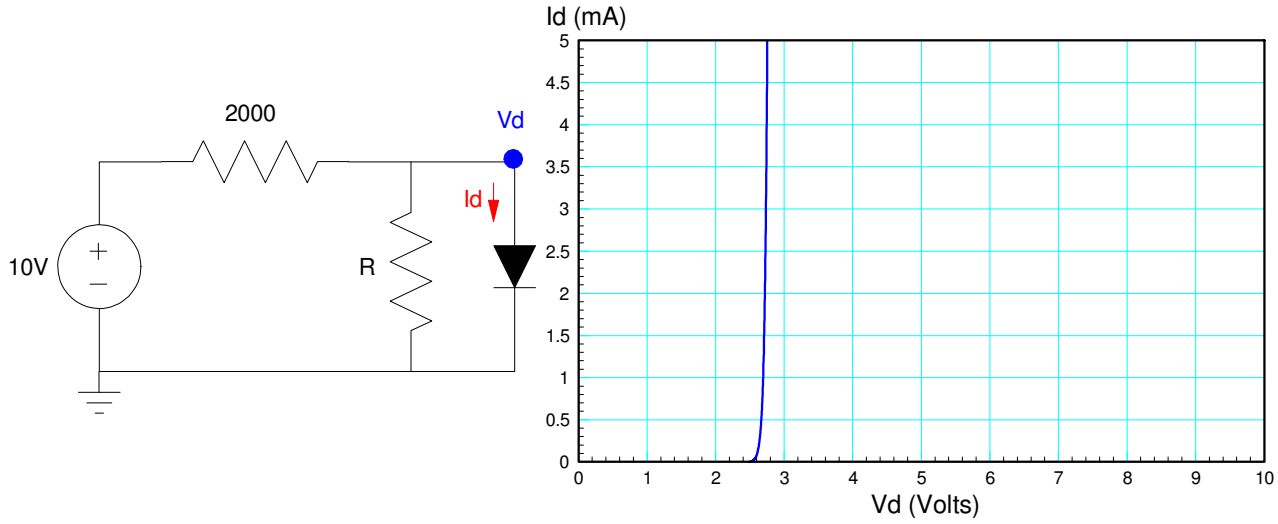
ECE 320 - Final (pt 1) - Name _____

Semiconductors & Diodes - Spring 2023

1) Load Lines: Assume the VI characteristics for the diode is as shown in the graph. Draw the load line for the following circuit and determine Id and Vd. Assume R = 800 + 100*(your birth month) + (your birth date).



R 800 + 100*mo + day	Load Line x-intercept (volts)	Load Line y-intercept (mA)	Vd Volts	Id mA

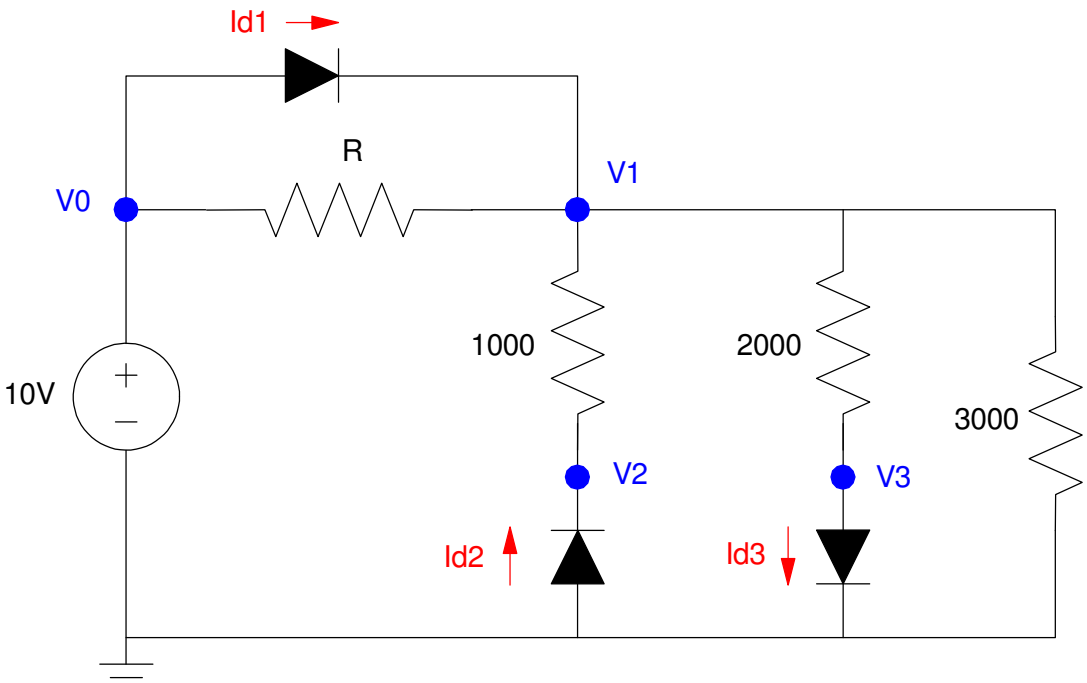
2) Nonlinear equations: Diode circuit

Assume the VI characteristics for the diodes shown below are

$$V_d = 0.038 \ln\left(10^{11} \cdot I_d + 1\right) \qquad I_d = 10^{-11} \cdot \left(\exp\left(\frac{V_d}{0.038}\right) - 1\right)$$

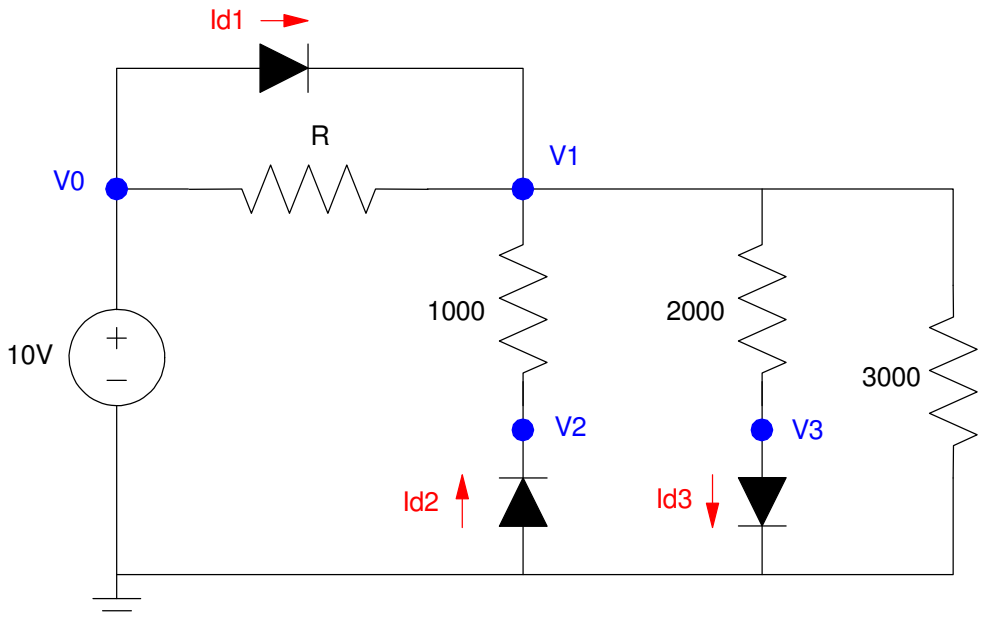
Write 6 equations to solve for 6 unknonws: {V1, V2, V3, V4, Id1, Id2, Id3}.

- Note: you do not need to solve.
- R = 800 + 100*(your birth month) + (birth date).



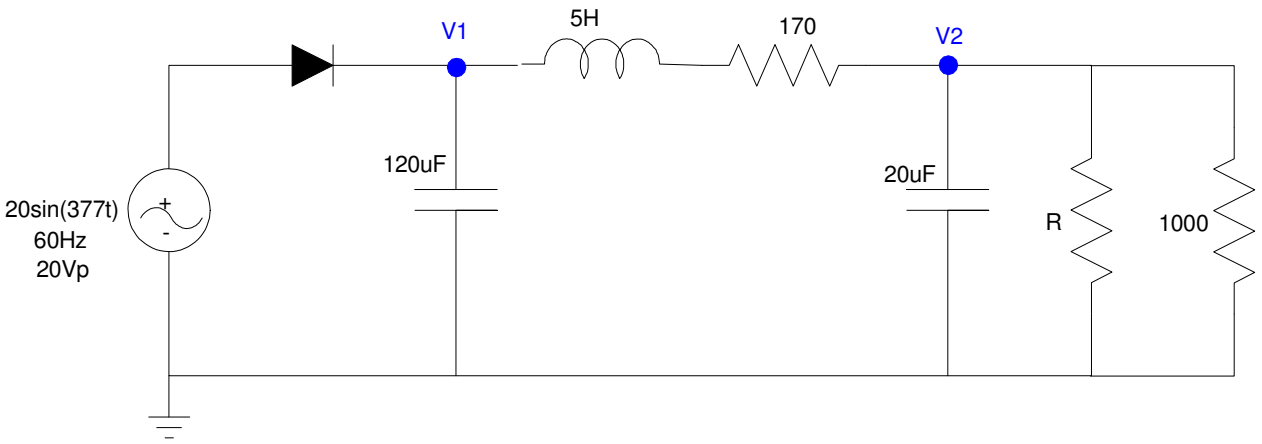
3) Ideal Silicon Diodes. Assume the diodes in this circuit are ideal silicon diodes:

- Vd = 0.7V Id > 0
- Id = 0 Vd < 0.7V
- R = 800 + 100*(your birth month) + (birth date).



R 800 + 100*mo + day	Id1	Id2	Id3
V1	V2	V3	V4

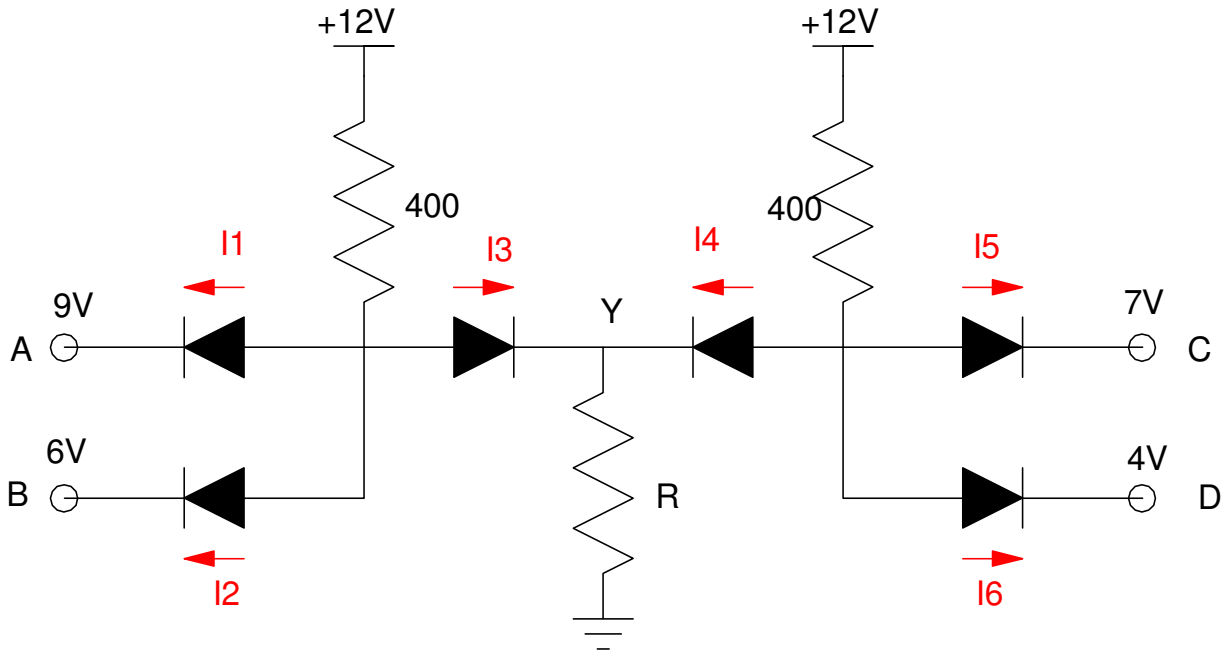
4) AC to DC: Analysis: Determine V1 and V2 (both DC and AC) for the following AC to DC converter



R 800 + 100*mo + day	V1		V2	
	DC	AC	DC	AC

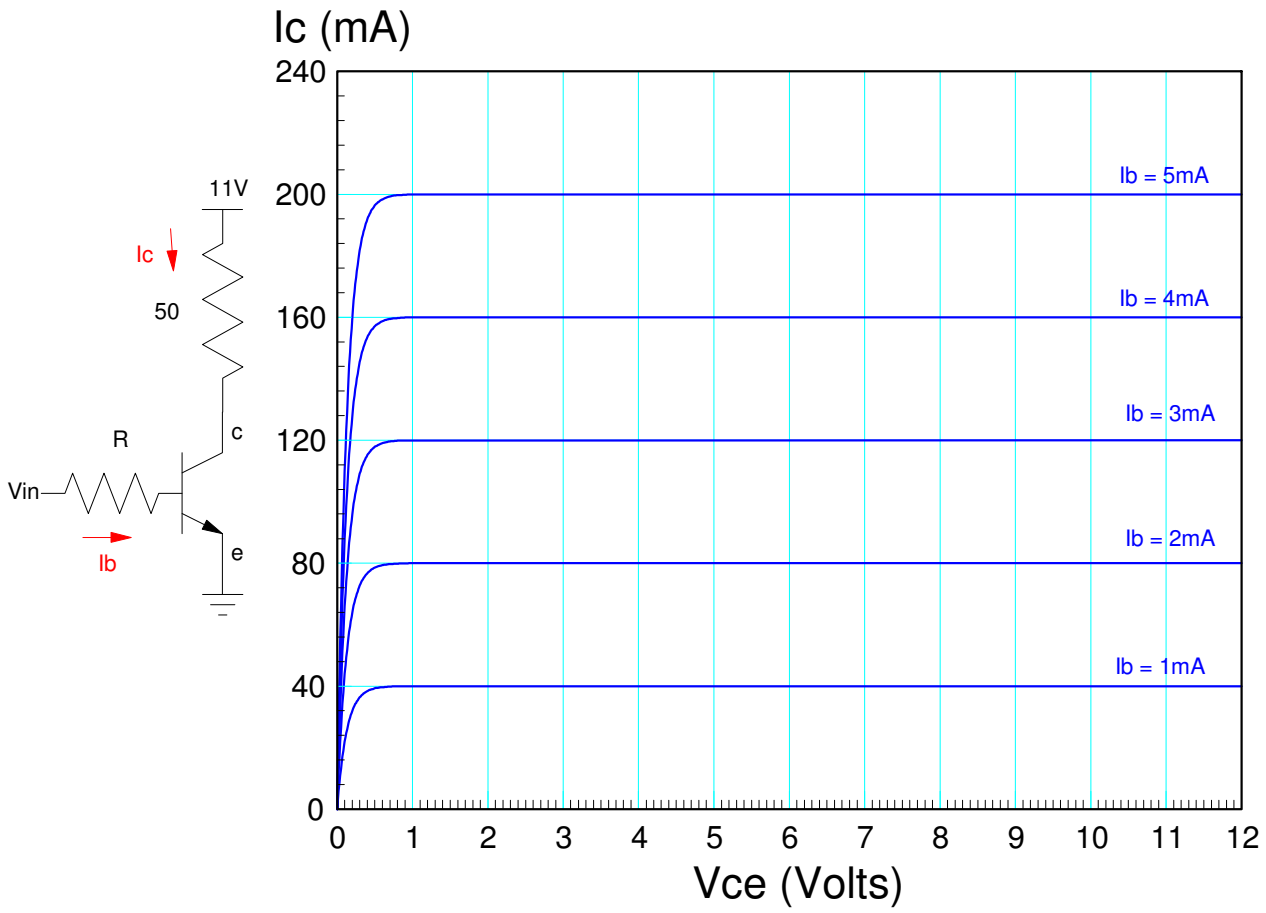
5) Max/Min Circuits. Determine the currents I1 .. I6. Assume

- Ideal silicon diodes (Vf = 0.7V)
- R = 800 + 100*(your birth month) + (birth date)



R 800 + 100*mo day	I1	I2	I3	I4	I5	I6

6) Determine the current gain, β. Also draw the load line and determine the operating point when Vin = 6V



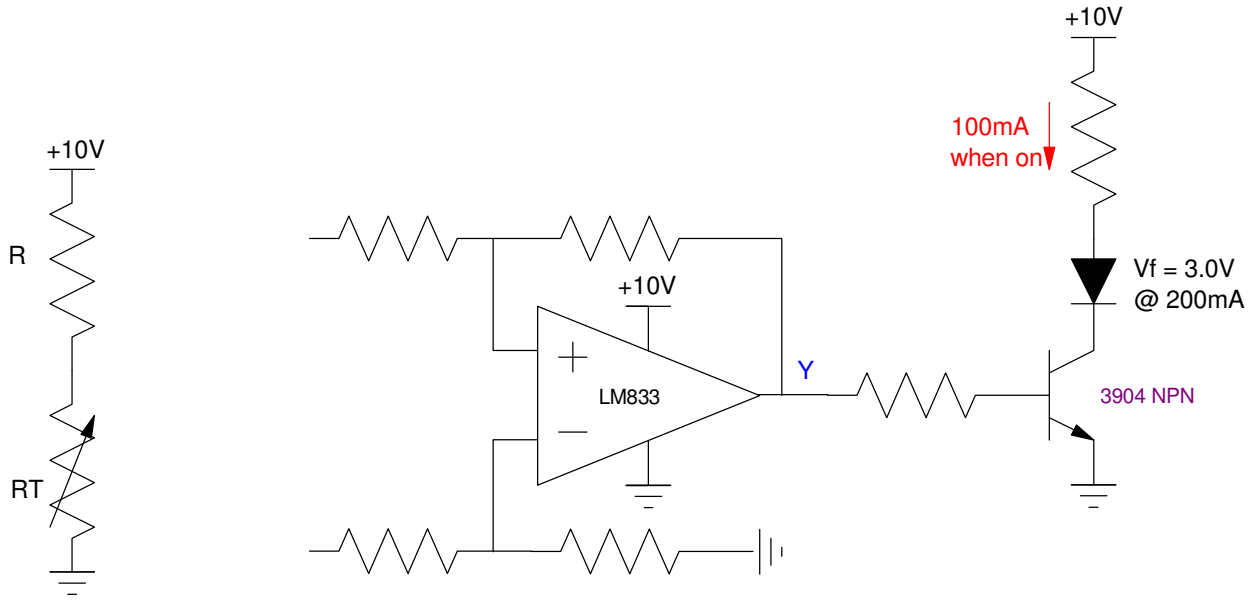
R 800 + 100*Mo + Day	Current Gain hfe = beta	Load Line x-intercept (Volts)	Load Line y-intercept (mA)	Vce Vin = 6V	Ic Vin = 6V

7) Design a Schmitt Trigger & transistor switch so that

- Turns on the LED at 100mA when Rt > 1500 Ohms
- Turns off the LED when Rt < 1300 Ohms

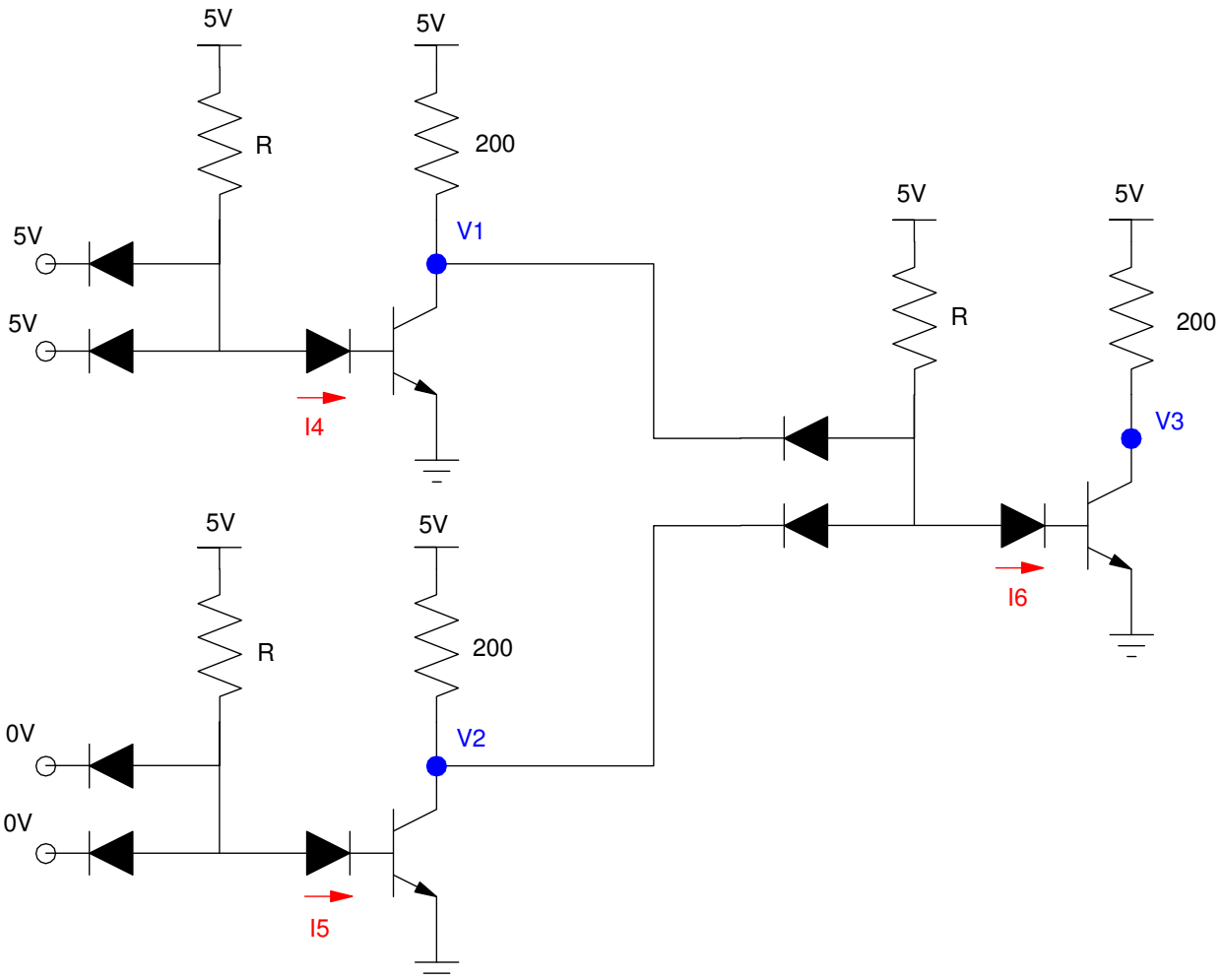
Assume

- R = 800 + 100*(your birth month) + (your birth date)
- Vce(sat) = 0.2V
- Current gain (β) = 100



8) DTL Logic: Determine the voltages and currents for the following DTL logic gage. Assume

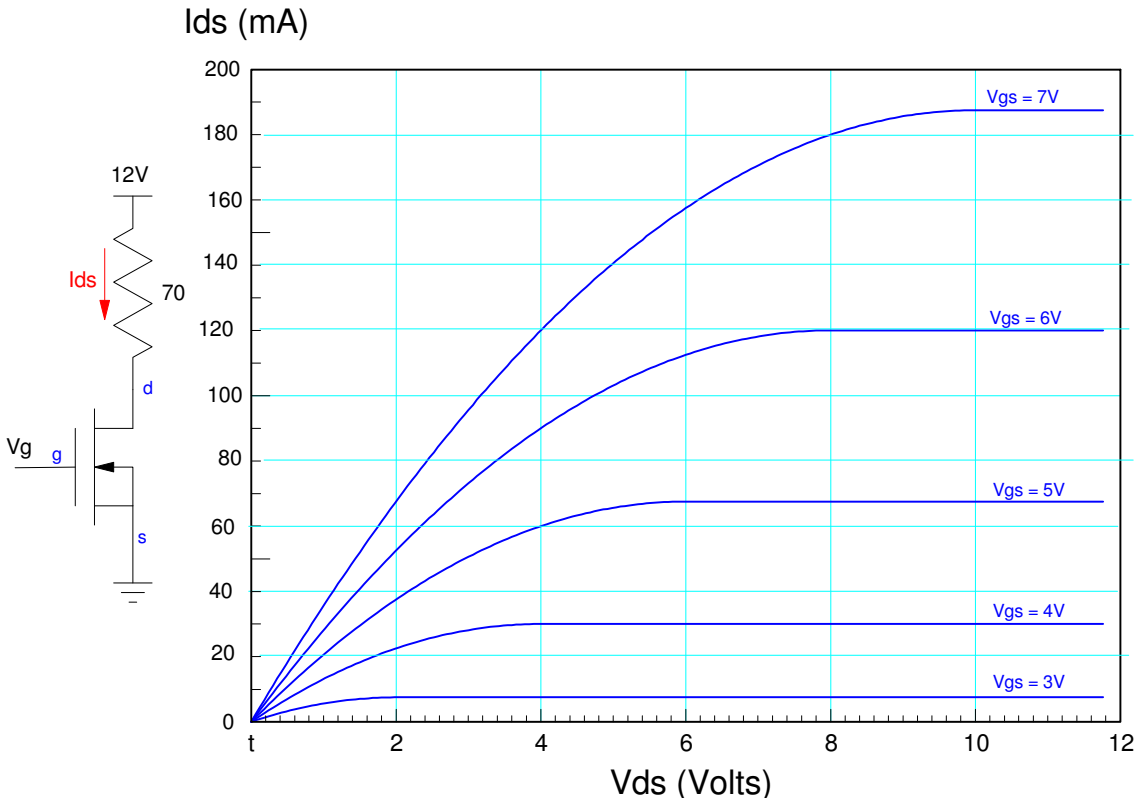
- R = 800 + 100*(your birth month) + (birth day)
- Ideal silicon diodes (Vf = 0.7V), and
- Ideal 3904 transistors (Vbe = 0.7V, Vce(sat) = 0.2V, β=100)



R 800 + 100*mo + da	V1	V2	V3	I4	I5	I6

9) MOSFET Load Line: For the following MOSFET circuit

- Determine the transconductance gain, kn,
- Draw the load line (x and y intercept), and
- Determine {Vds, Ids} when Vg = 7V. (note: Vth = 2V)



kn transconductance gain	Load Line x=intercept	Load Line y intercept	Vds Vg = 7V	Ids Vg = 7V	Operating Region off / active / ohmic

10) CMOS Logic

Design a CMOS logic gate to implement Y=f(A,B,C,D)

AB \ CD	00	01	11	10
00	1	0	1	1
01	x	0	x	1
11	1	0	0	x
10	1	1	0	0