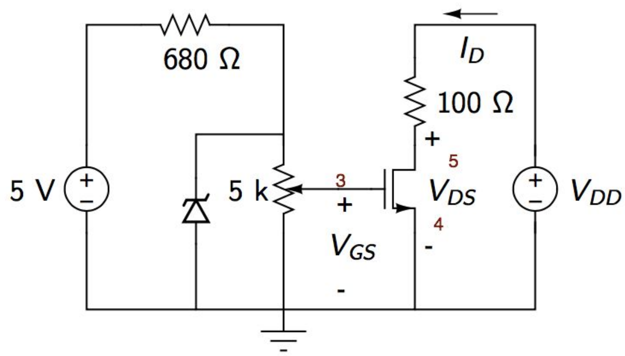
EE 236 Lab Report
Basic Electronic Devices

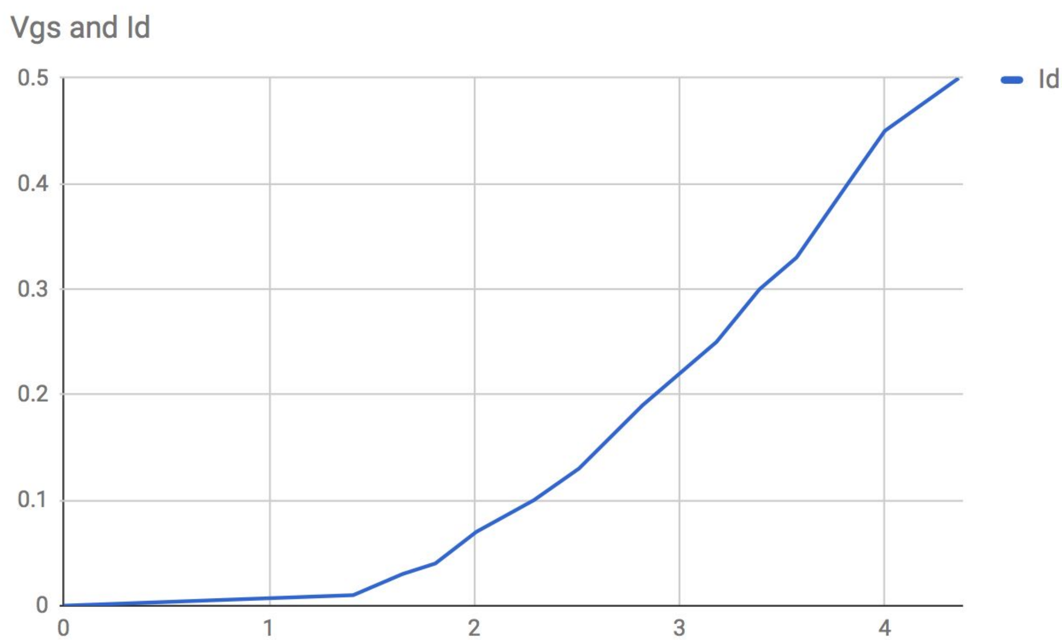
Experiment No. 7

Name : Devesh Kumar — Roll No: 16d070044
Batch:Monday — Table No: 20
Name of TA/RA :Arindam Sarkar

Part 1



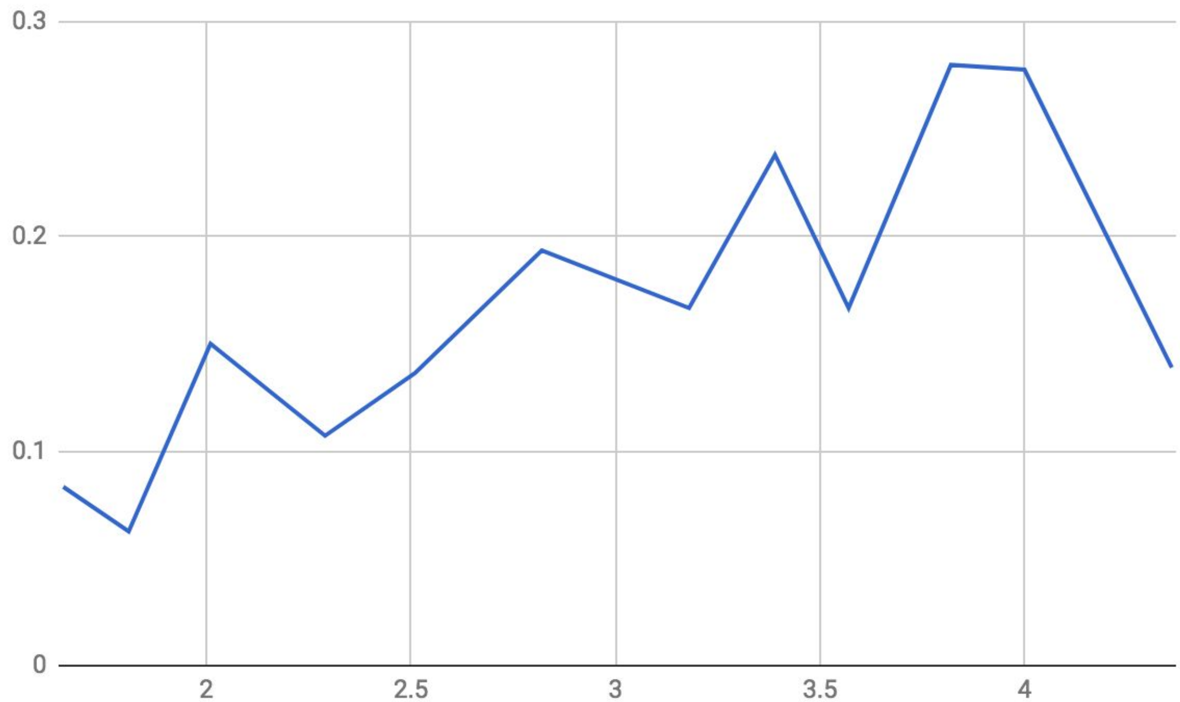
Q1 Plot a graph of I_D v/s V_{GS} on a linear scale.



Q2 Extrapolate the linear portion of the plot as shown below to find the intercept on the V_{GS} axis. This will give you the threshold voltage V_{TN}.

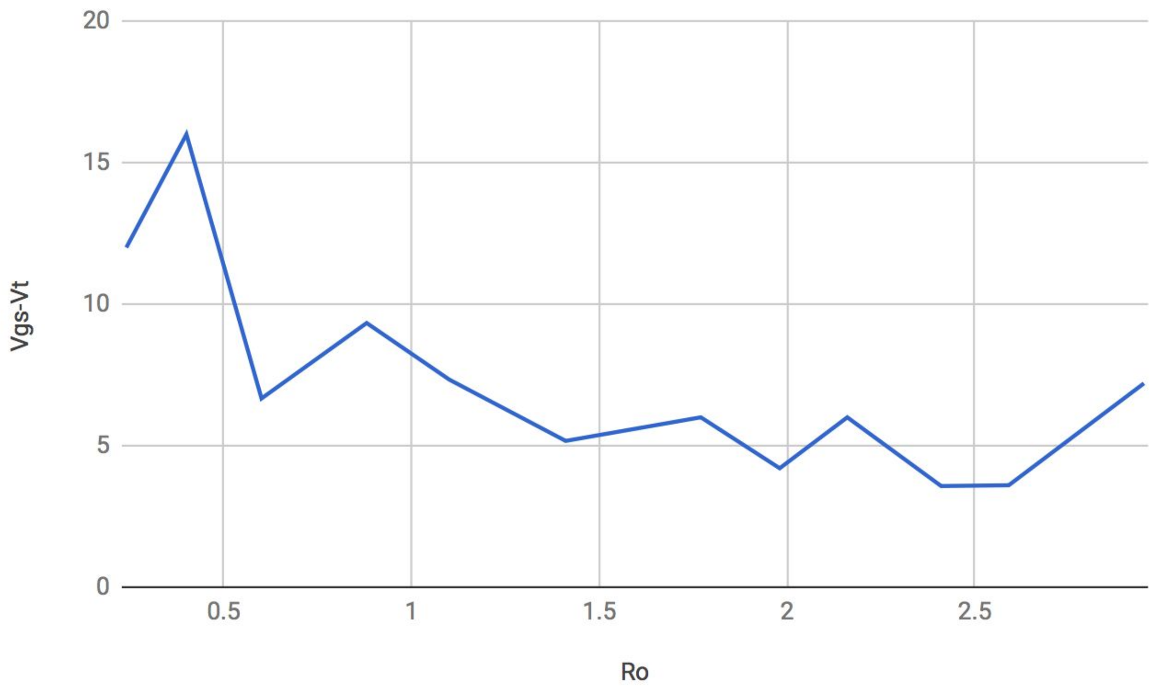
Vtv= 1.4 v

Q3 Also compute the transconductance $g_m = \partial I_D / \partial V_{GS}$. At what value of V_{GS} is the g_m maximum?



3.2V

Q4 Calculate the linear region resistance r_o and plot it as a function of $V_{GS} - V_{TN}$.



Q5 Calculate the subthreshold slope (below V_{TN}) SS = $(\partial \ln I_D / \partial V_{GS})^{-1}$ in units

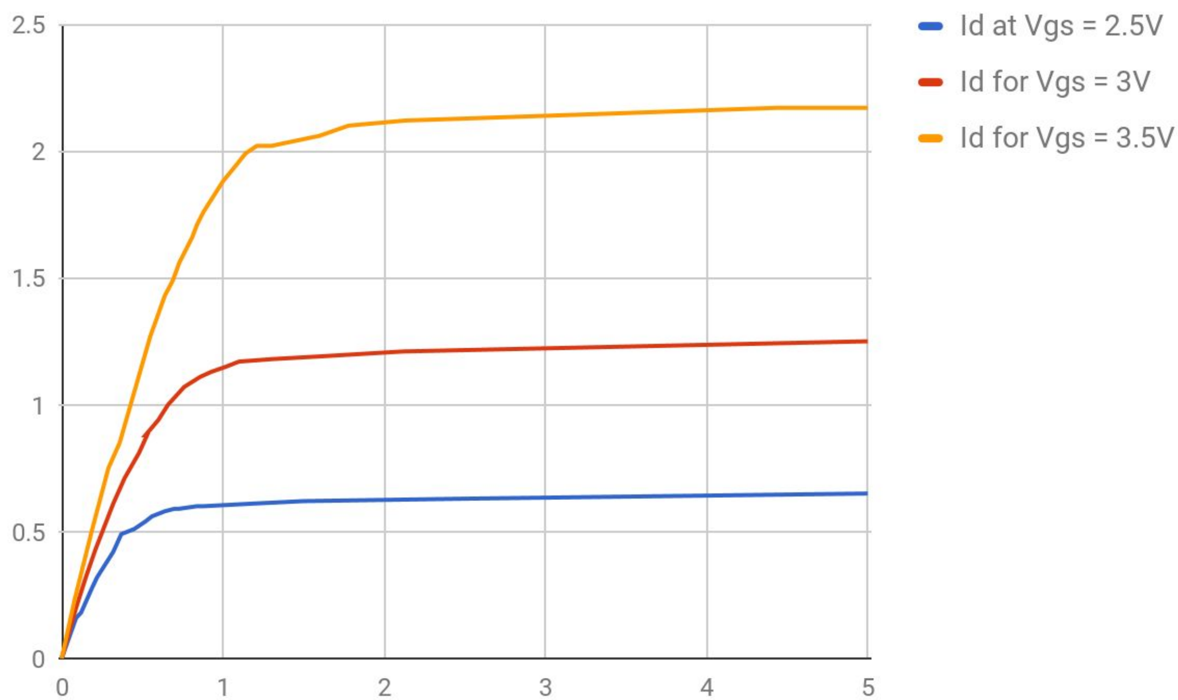
mV/decade.

60 mV /decade

Part 2

Q1 Plot a graph of I_D v/s V_{DS} on a linear scale. For each value of V_{GS} , you have

one set of I_D-V_{DS} data. Plot all of these on the same graph, as shown below.



Q2 From the slope of the linear portion of the graph, calculate the output drain-source resistance r_o at V_{DS} = 5 V for different values of V_{GS} as

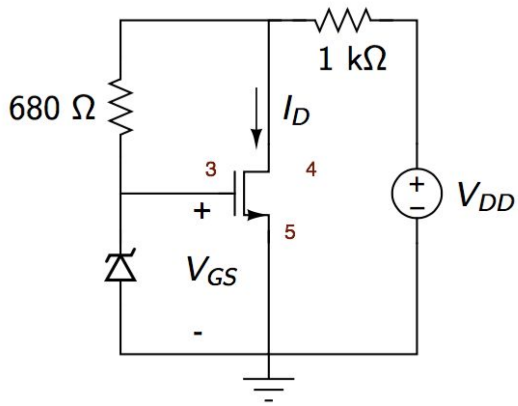
vgs	Ro
2.5	123
3	72
3.5	57.4

R in kohm and v in volts

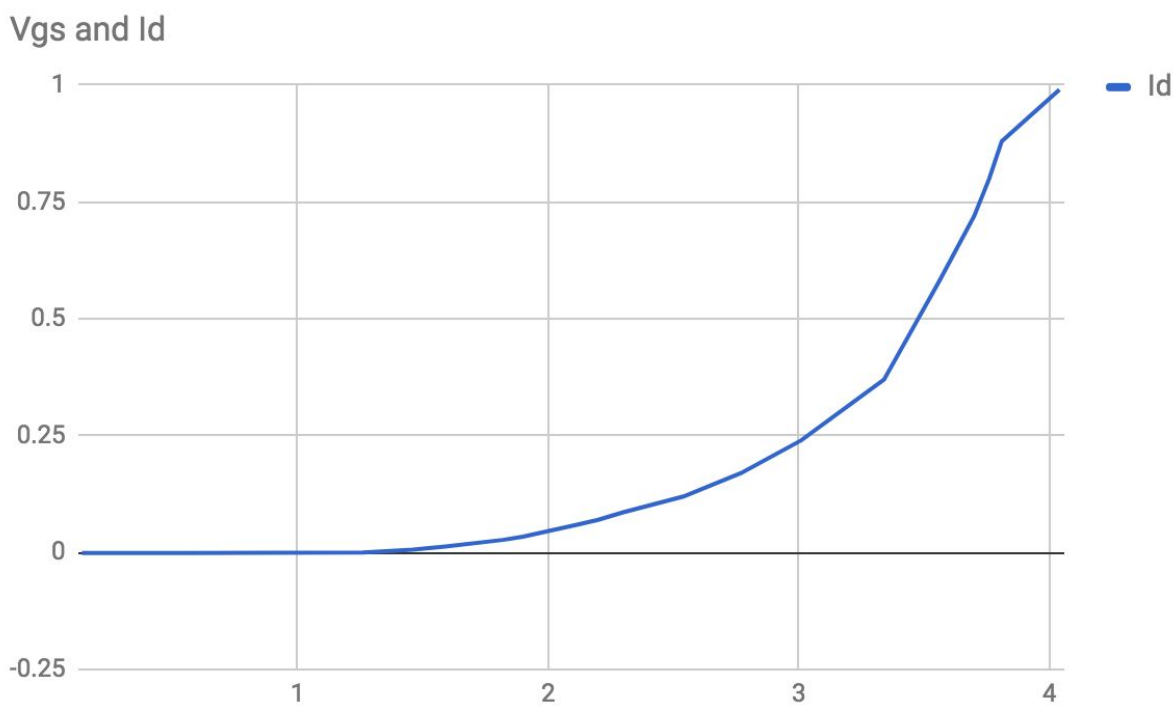
Q3 Extrapolate the linear portion of the graph to find the intercept on the V_{DS} axis. This will give you the Early Voltage V_A.

Approximately 89V for each

Part 3

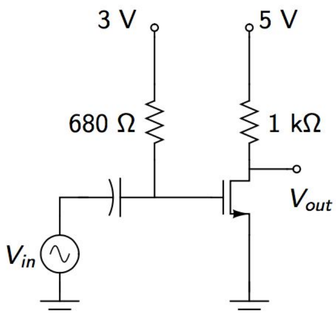


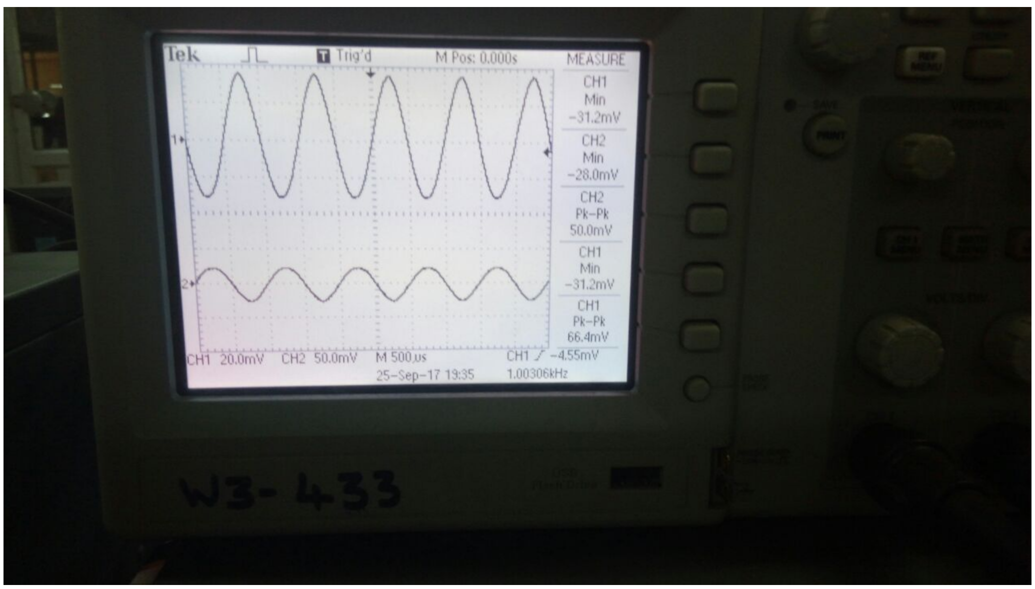
Plot a graph of I_D v/s V_{GS} on a linear scale. Comment on the nature of the plot



Constant till Vtl . then rises quadratically .

Part 4





gain =1.28

Rd = 1k

Gm= 1.28x10^-3 Mho

Q1 Find out the effect on the threshold voltage of the NMOS, if

a. Positive Body voltage is applied.

Applying a positive voltage takes away negative charge from the p substrate and brings down the required potential thus Vt would reduce

b. Negative Body voltage is applied.

A negative voltage will have reverse effect ,and the negative charge in channel will increase the potential Required at gate thus Vt will increase

Q2 Subthreshold slope is a key metric for any switching device. Why?

An infinite Subthreshold slope performs fast switching and hence spend a significant time in low voltage region . it also has infinite resistance in this region so it will be perfect for switching circuit

Q3 The linear region of the $I_D - V_{GS}$ curve is not perfectly linear. Its slope increases first and decreases after attaining a peak value. For such a case, find out an accurate method to calculate the threshold voltage.

The region is not completely linear because of second order effect

To find an accurate threshold voltage we can look at the latter part of the linear region actually cuts the axis when extrapolated .

This would give suitable point for vt .linear effects are valid when Vgs is large enough for Vds<Vgs-Vt

Q4

Given the $I_D - V_{GS}$ characteristics in saturation, how will you find the threshold voltage?

To find Vt we will plot root Id vs Vgs as the plot will be zero till Vgs is equal to Vt and will be linear after that (as we have seen in the simulation). Point where extrapolated linear region cuts x axis is Vt