EE236: Experiment No. 9
N Channel MOSFET Characteristics

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1 Overview of the experiment

1.1 Aim of the experiment

The aim of the experiment is to measure output and transfer characteristics of a NMOS transistor. To also investigate the effect of body bias on the characteristics of the NMOS.

1.2 Lab Experiment

1.3 Part 1 - Transfer Characteristics (Linear)

1.3.1 Circuit Used for Part 1

1.3.2 Readings Obtained

V_GS (in V)	I_D (in mA)
1.21	0.001
1.275	0.003
1.316	0.006
1.369	0.011
1.62	0.052
1.67	0.067
1.68	0.070
1.74	0.084
1.77	0.094
1.83	0.115
1.93	0.145
2.10	0.178
2.15	0.187
2.18	0.197
2.24	0.205
2.36	0.221
2.42	0.231
2.48	0.245
2.51	0.252
2.57	0.267
2.84	0.320
2.94	0.330
3.01	0.334

Table 1: V_DS = 0.2V, Linear Region Readings

1.3.3 Plot Obtained

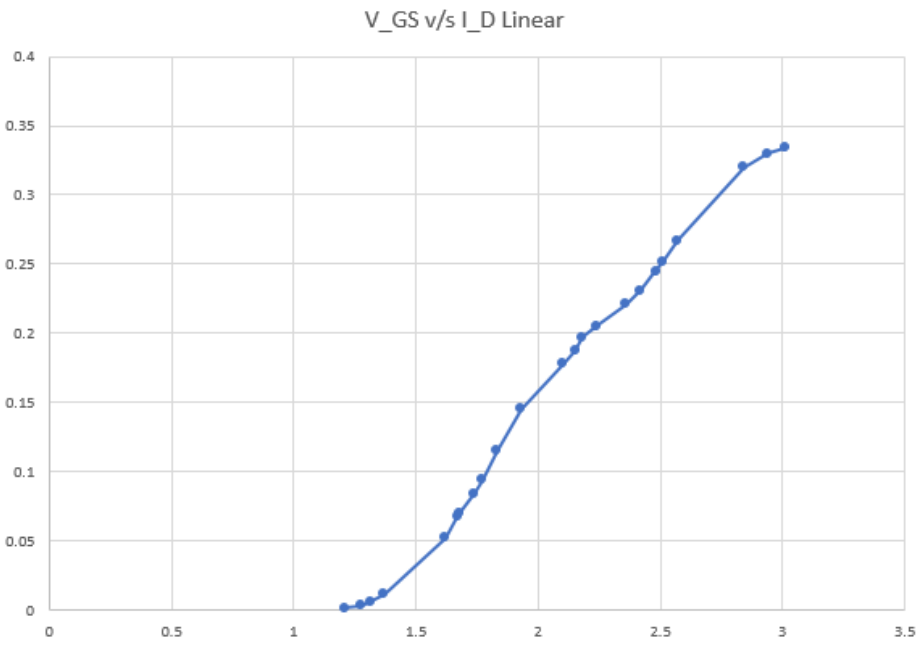

Figure 1: Transfer Characteristics Linear Plot

1.4 Part 1 - Transfer Characteristics (Saturation)

1.4.1 Circuit Used for Part 1

1.4.2 Readings Obtained

V_GS (in V)	I_D (in mA)
1.135	0
1.365	0.015
1.38	0.024
1.442	0.028
1.495	0.034
1.545	0.041
1.584	0.054
1.615	0.064
1.67	0.081
1.715	0.105
1.762	0.124
1.78	0.132
1.795	0.135
1.81	0.145
1.834	0.160
1.854	0.162
1.882	0.174
1.915	0.198
1.94	0.215
1.979	0.235
2.01	0.265
2.21	0.412
2.31	0.481
2.39	0.564
2.49	0.645
2.61	0.762
2.71	0.862
2.82	0.971
2.9	1.054
3.00	1.145

Table 2: V_DS = 3V, Saturation Region Readings

1.4.3 Plot Obtained

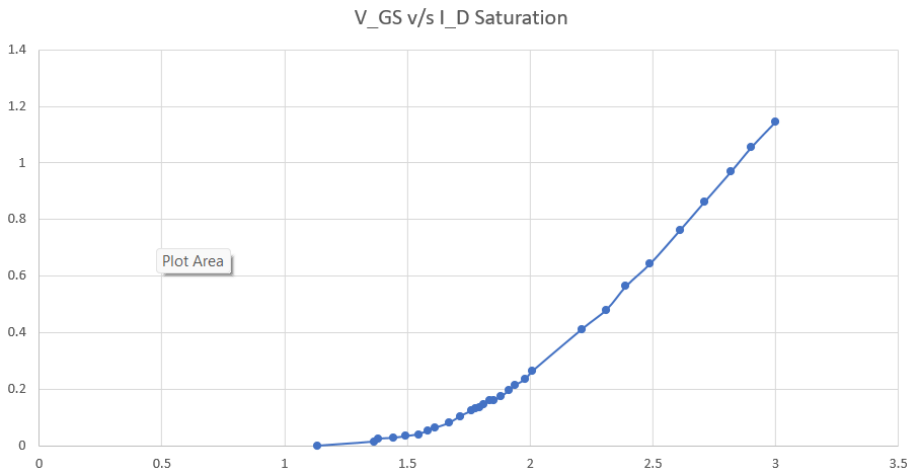

Figure 2: Transfer Characteristics Saturation Plot

1.5 Part 2 - Drain Characteristics

1.5.1 Circuit Used for Part 2

1.5.2 Readings Obtained

V_DS (in V)	I_D (mA)
0.02	0.008
0.03	0.014
0.10	0.052
0.20	0.096
0.26	0.112
0.30	0.118
0.34	0.122
0.39	0.125
0.44	0.127
0.50	0.128
0.56	0.128
0.68	0.129
0.78	0.130
0.90	0.130
1.10	0.131
1.30	0.131
1.50	0.132
1.70	0.132
1.90	0.132
2.10	0.132
2.40	0.133
2.70	0.134
3.00	0.134
3.30	0.135
3.60	0.135
3.90	0.135
4.20	0.136
4.50	0.136
4.80	0.137
5.00	0.137

Table 3: V_GS = 1.5V

V_DS (in V)	I_D (mA)
0.25	0.295
0.45	0.473
0.65	0.589
0.85	0.646
1.05	0.664
1.25	0.670
1.45	0.673
1.65	0.675
1.85	0.677
2.05	0.678
2.25	0.680
2.45	0.681
2.65	0.682
2.85	0.683
3.05	0.684
3.25	0.685
3.45	0.686
3.65	0.686
3.85	0.687
4.05	0.688
4.25	0.688
4.45	0.689
4.65	0.690
4.85	0.691
5.00	0.691

Table 4: V_GS = 2.5V

V_DS (in V)	I_D (mA)
0.25	0.540
0.45	0.930
0.65	1.260
0.85	1.540
1.05	1.740
1.25	1.880
1.45	1.990
1.65	2.030
1.85	2.050
2.05	2.070
2.25	2.080
2.45	2.080
2.65	2.080
2.85	2.080
3.05	2.090
3.25	2.090
3.45	2.100
3.65	2.100
3.85	2.100
4.05	2.110
4.25	2.110
4.45	2.110
4.65	2.110
4.85	2.120
5.00	2.120

Table 5: V_GS = 3.5V

1.5.3 Plot Obtained

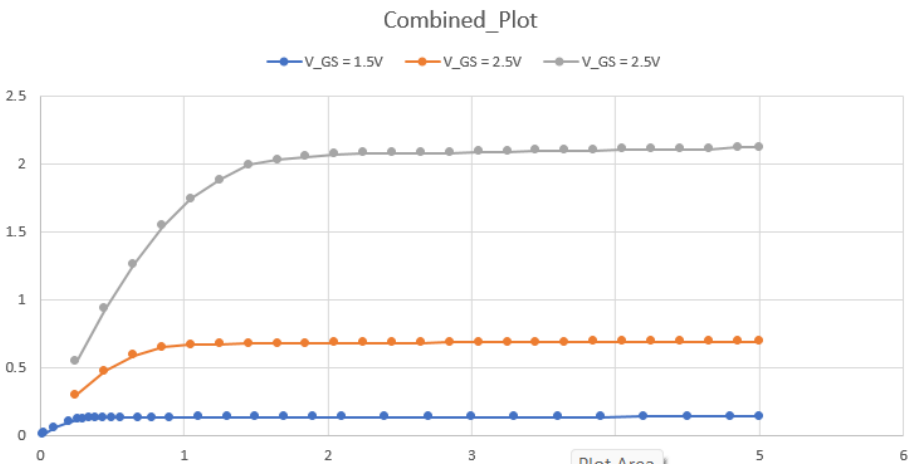

Figure 3: Combined Drain Characteristics plot

1.6 Part 3 - Body Effect

1.6.1 Circuit Used for Part 3

1.6.2 Readings Obtained

V_GS (in V)	I_D (mA)
2.24	0
2.28	0.002
2.60	0.040
2.83	0.110
3.02	0.170
3.23	0.210
3.44	0.264
3.68	0.307
4.01	0.384
4.15	0.402
4.54	0.485
4.75	0.510
4.95	0.534

Table 6: V_SB = 1V

V_GS (in V)	I_D (mA)
3.04	0
3.12	0.002
3.41	0.052
3.54	0.105
3.81	0.145
4.04	0.203
4.32	0.271
4.43	0.310
4.77	0.351
4.95	0.394

Table 7: V_SB = 2V

V_GS (in V)	I_D (mA)
3.71	0
3.75	0.001
4.08	0.047
4.16	0.065
4.25	0.088
4.35	0.112
4.51	0.152
4.59	0.170
4.66	0.192
4.78	0.215
4.85	0.235
4.95	0.254

Table 8: V_SB = 3V

1.6.3 Plot Obtained

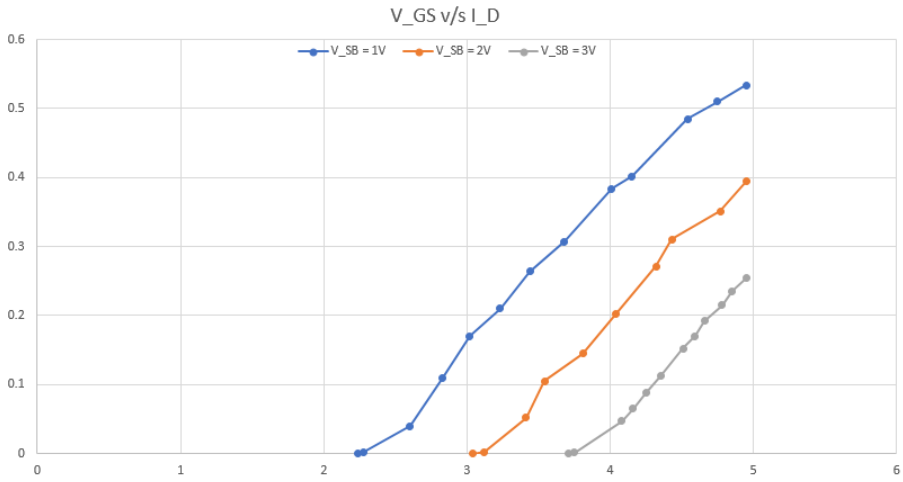

Figure 4: Combined Body Effect Plot

1.6.4 V_SB vs V_T Readings

V_SB (in V)	V_T (in V)
0	1.22
1	2.26
2	3.05
3	3.70

Table 9: V_SB vs V_T Readings

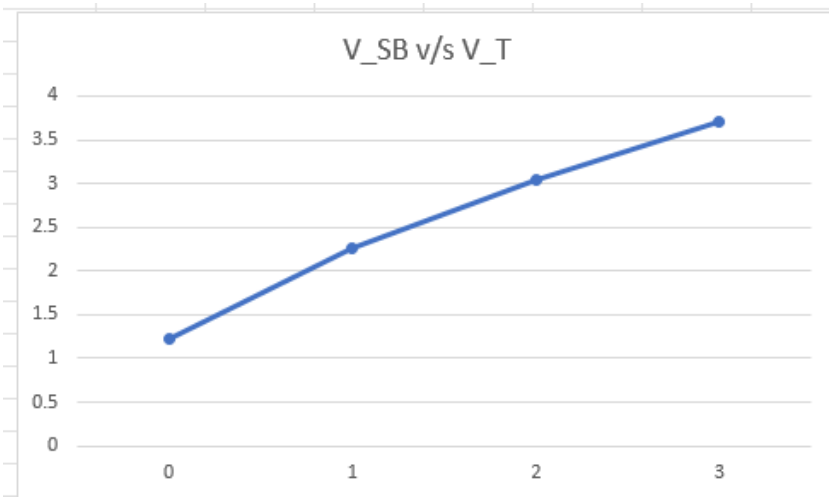

Figure 5: Plot of V_SB vs V_T

2 Calculations

2.1 Part 1

For Linear Region, Id = K(Vsg - Vt - 0.1) as Vsd = 0.2V. The value of K was approximated from the graph for the linear area region as 29.56e-6 A/V. The Vt is calculated as Vsg - Id/K - 0.1, for Vsg = 1.8V was obtained as 0.123 V.

The value of gm is nothing but the slope, which is K which we got as 29.56µA/V.