EE236: Experiment No. 8
P-channel MOSFET I-V Characteristics

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1 Overview of the experiment

1.1 Aim of the experiment

- Measuring output and transfer characteristics of a P-channel enhancement type MOSFET (also called PMOS).
- Investigating the effect of body bias on the characteristics of the PMOS.

1.2 Methods

- Obtaining the values of Vt and gm using the plot of linear Transfer Characteristics of the mosfet.

$$gm = del(ID)/del(VSG)|atconstVSD \tag{1}$$

- finding the output resistance ro using the slope of the plot of ID vs Vsd for drain characteristics.

$$ro = del(VSD)/del(ID)|atconstVSG \tag{2}$$

- finding the body effect co-efficient by plotting VT vs Vsb by changing the Vsb.
- VT= $\mathrm{VT}_o + gamma(sqrt(si(s) - Vsb) - sqrt(si(s)))$

2 Design

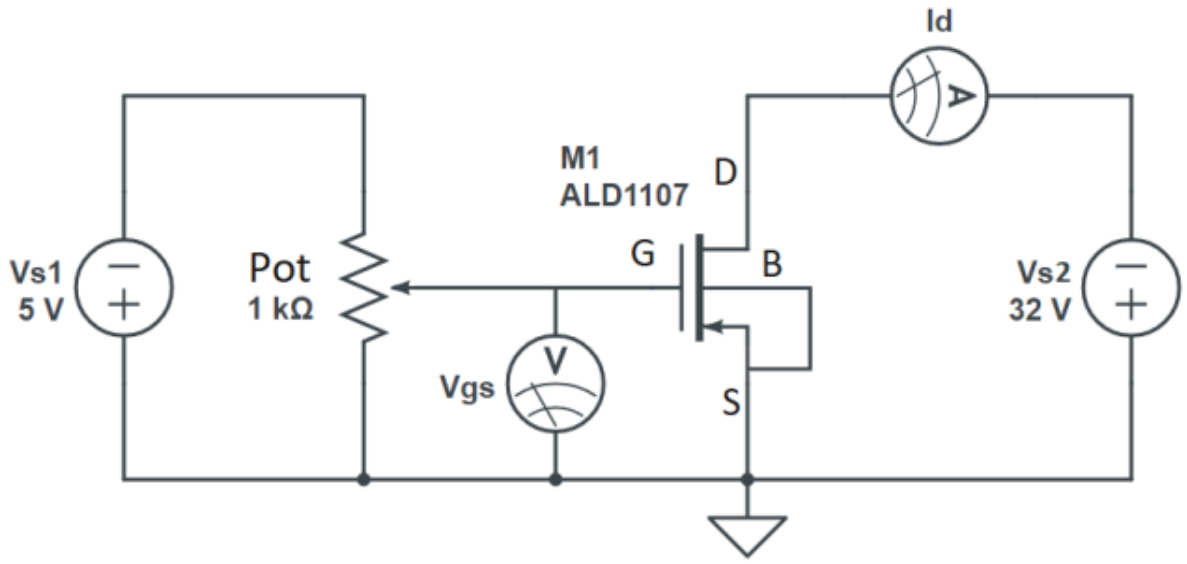

Figure 1: Circuit for linear transfer characteristics and drain characteristics
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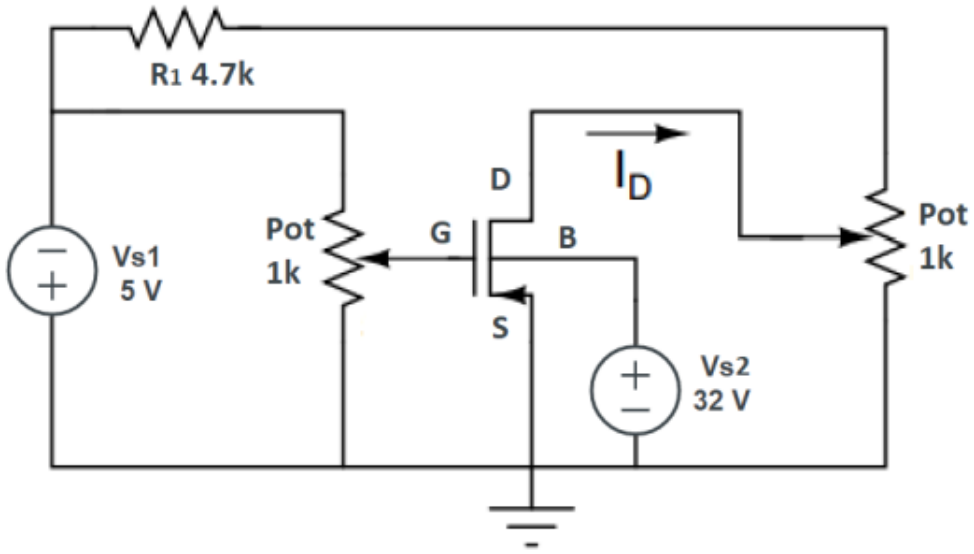

Figure 2: PMOS body effect circuit.

2.1 Experimental results

gm = 4/0.15 = 13.35. r0 = 0.5/0.59 = 0.81. **gamma = 0.397.**

part(1)

VSD = 5V VSD = .2V

ID	VSG	ID	VSG
0	0.07	0	0.2
0	0.58	0	0.799
0	0.9	0.072	1.89
0.015	1	0.082	2.07
0.038	1.19	0.095	2.3
0.045	1.23	0.106	2.54
0.063	1.34	0.119	2.82
0.121	1.59	0.128	3
0.157	1.72	0.136	3.23
0.215	1.91	0.152	3.61
0.293	2.13	0.165	4.14
0.319	2.19	0.178	4.38

0.352 2.28 0.184 4.6
0.4 2.4 0.191 4.81
0.638 2.91 0.193 4.88
0.829 3.28 0.196 4.97
0.953 3.5
1.245 3.99
1.376 4.19
1.543 4.45
1.9 4.97

part(2)

Vsd Id1 Id2 Id3
0.02 0.005
0.27 0.051
0.48 0.073
0.59 0.079
0.74 0.083
0.85 0.085
1.93 0.092
2.07 0.093
3.51 0.099
3.78 0.1
4 0.101
4.33 0.102
4.72 0.103
5.05 0.104
0.02 0.01
0.19 0.084
0.28 0.122
0.35 0.146
0.39 0.162
0.63 0.24
0.75 0.273

0.92 0.311
1.46 0.383

2.14 0.406
2.64 0.416
3.08 0.423
3.72 0.432
4.21 0.438
4.45 0.44
5.05 0.447
0.02 0.014
0.19 0.124
0.3 0.185
0.42 0.257
0.53 0.312
0.58 0.342
0.73 0.415
0.96 0.518
1.21 0.618
1.4 0.681
1.9 0.807
2.55 0.883
2.76 0.895
3.07 0.909
3.74 0.932
3.98 0.939
4.63 0.955
4.91 0.961
5.02 0.963

Part(3)

Vsg Vsb = -1
0.01 0
0.95 0
0.984 0.001
1.14 0.005
1.18 0.008
1.25 0.012

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1.38 0.019
1.48 0.025
1.56 0.029
1.73 0.04
2.05 0.055
2.2 0.064
2.49 0.077
2.83 0.09
3.13 0.099
3.69 0.115
3.87 0.12
4.47 0.144
4.88 0.159
5 0.165

Vsg          Vsb = -2
0.01 0
0.1 0
1.07 0
1.09 0.001
1.24 0.005
1.34 0.01
1.41 0.014
1.53 0.021
1.67 0.028
1.8 0.034
2.08 0.054

2.22 0.056
2.47 0.066
2.63 0.076
2.84 0.084
3.12 0.093
3.32 0.1
3.51 0.112
3.75 0.119
3.98 0.126
4.14 0.13
```

```
4.55 0.14
4.72 0.144
5 0.15

 Vgs              Vsb = -3
0.01 0
0.39 0
1.18 0
1.195 0.001
1.26 0.002
1.39 0.008
1.47 0.012
1.67 0.022
1.85 0.032
1.99 0.038
2.19 0.046
2.51 0.065
2.76 0.074
3.2 0.09
3.39 0.1
3.67 0.108
3.97 0.116
4.18 0.122
4.51 0.13
5 0.141
```

```
Vsb Vt gamma
0 0.78
-1 0.958 0.398020099994962
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-2 1.09 0.39800082283055
-3 1.195 0.39339040496137
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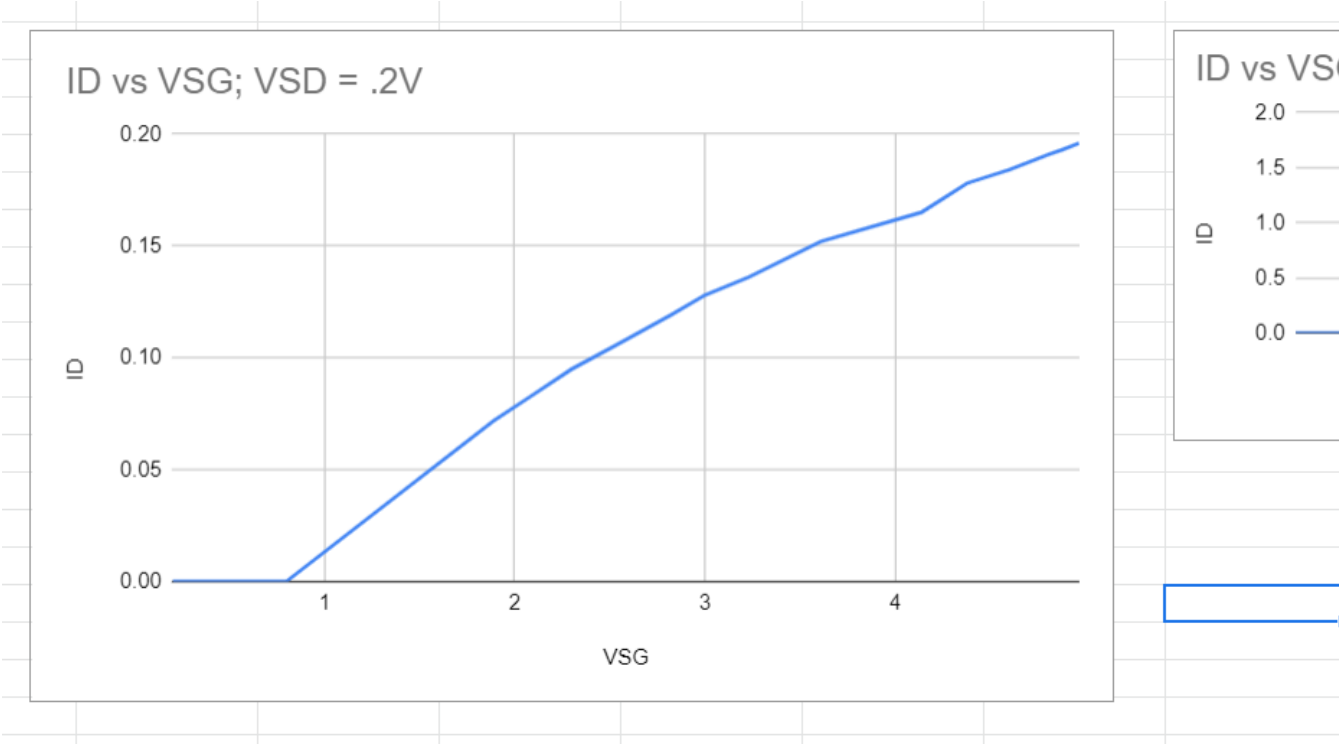

Figure 3: ID vs VSG

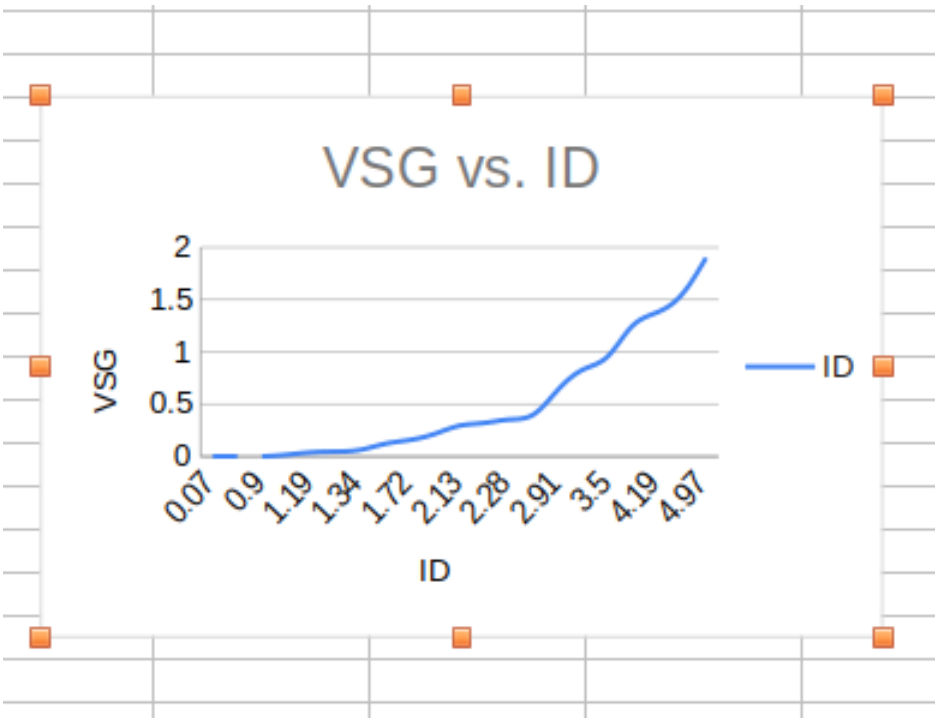

Figure 4: Vsd vs Id

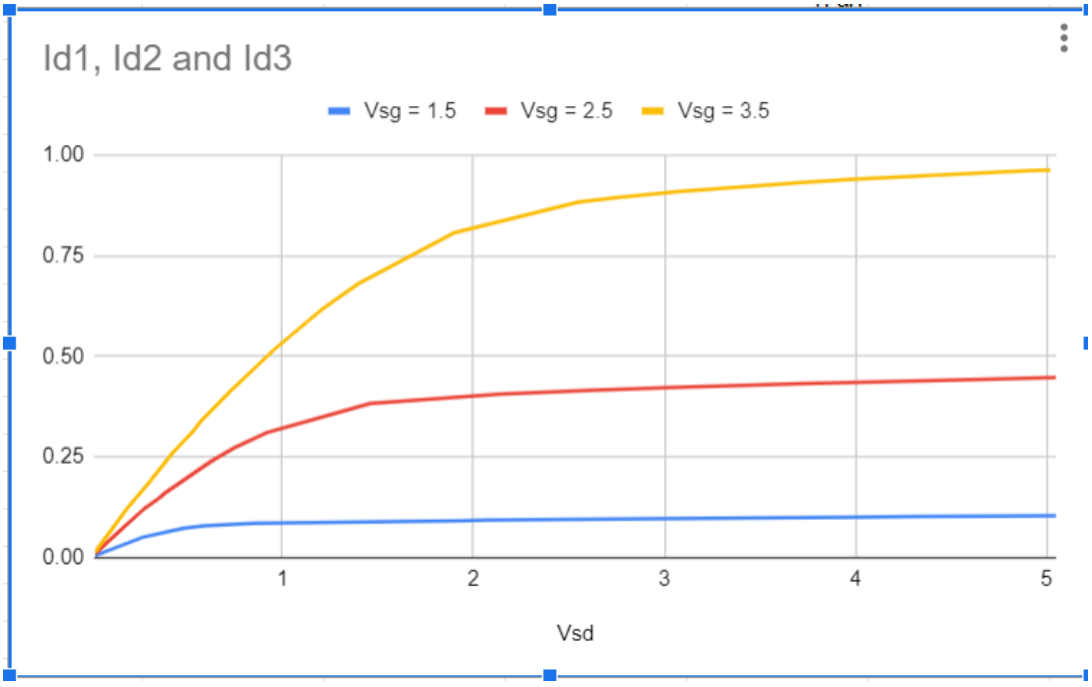

Figure 5: part2

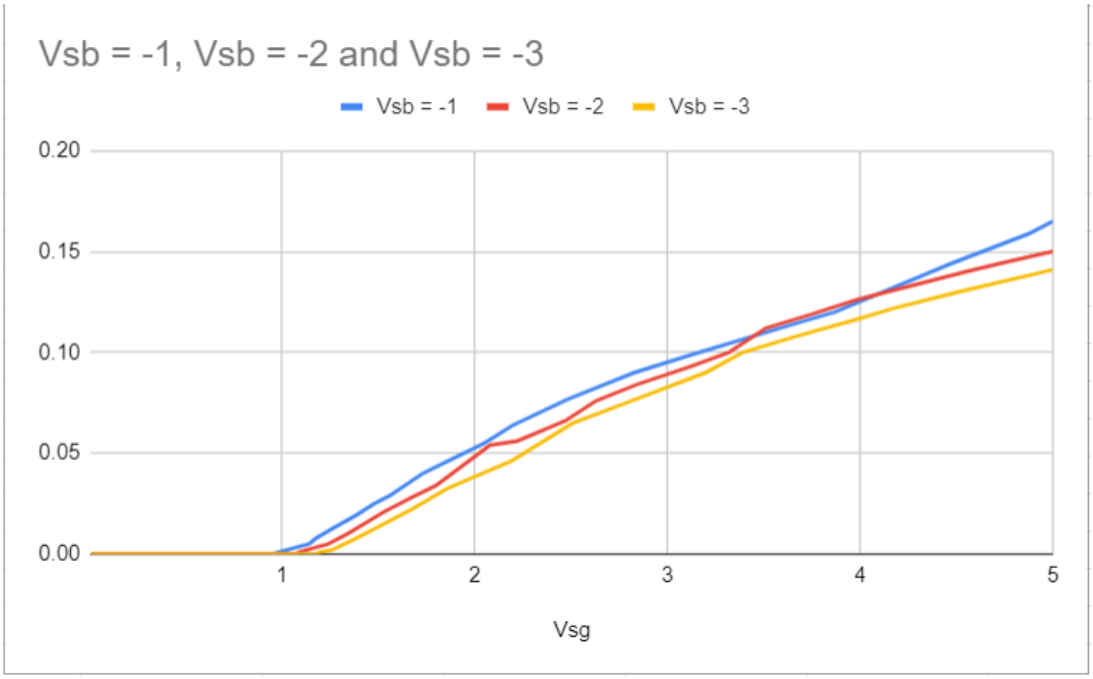

Figure 6: Part 3 - ID vs VSG

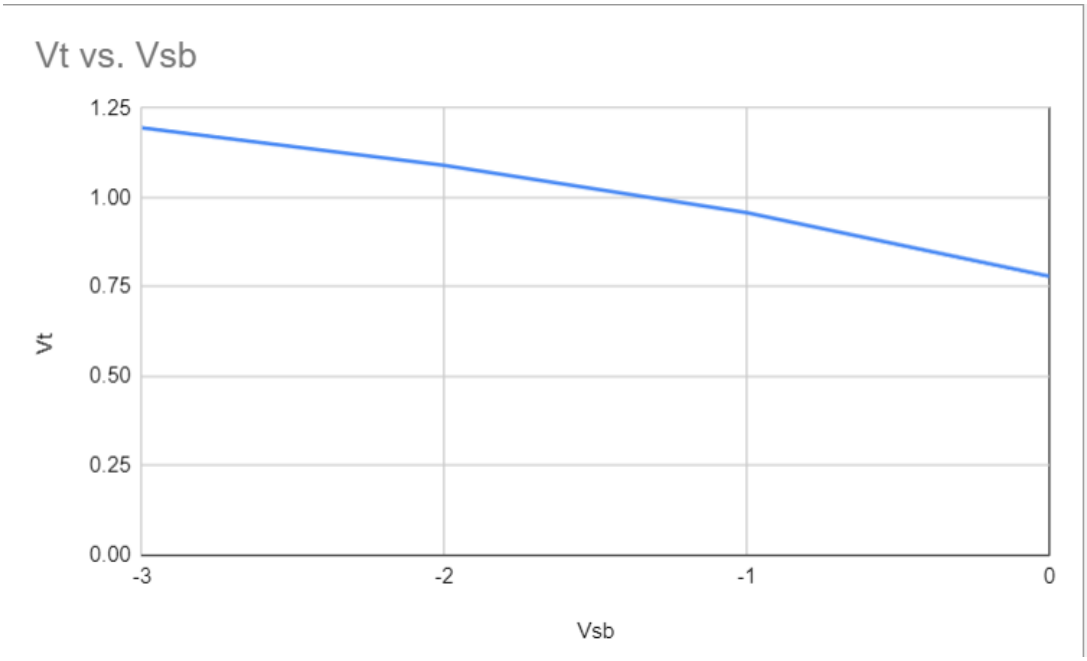

Figure 7: Part 3 - Vt vs Vsb