HW-1

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Problem - 1

a

$$N = \frac{\pi {w_r}^2}{{d_e}^2} - \frac{2\pi w_r}{\sqrt{2} d_e} = \pi(\frac{w_r}{d_e})^2 - \sqrt{2}\pi\frac{w_r}{d_e} = \pi\frac{w_r}{d_e}(\frac{w_r}{d_e} - \sqrt{2}) \tag{1}$$

Where N is the number of useful dies on the wafer in terms of w_r and d_e.

b

With result from a, it is clear that $N > 0$. Thus $\frac{w_r}{d_e} > \sqrt{2}$.

c

Let $R_{wd} = \frac{w_r}{d_e}$. Thus

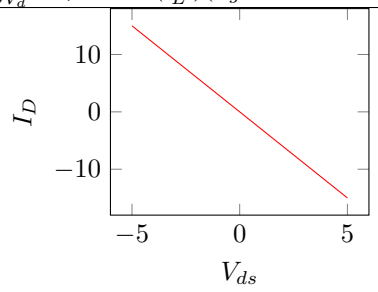
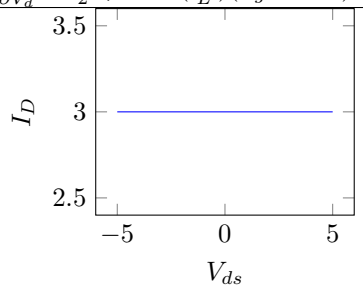
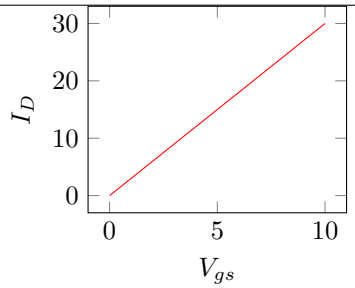
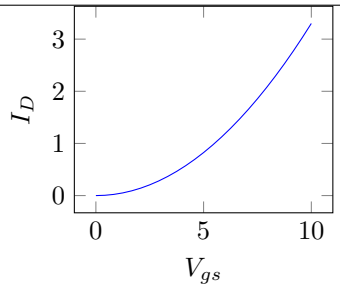
$$N = \pi R_{wd}(R_{wd} - \sqrt{2}) \tag{2}$$

d

As die yield formula is not allowed to use in HW-1. I could only assume that dies on the wafer with defect is $ND - d$, Thus wafer yield can be calculated as following:

$$Y = N(1 - D_d) = \pi\frac{w_r}{d_e}(\frac{w_r}{d_e} - \sqrt{2})(1 - D_d) \tag{3}$$

Problem - 2

Linear opeartion	Saturation operation
$\frac{\partial I_D}{\partial V_d} = \mu_n C_{OX}(\frac{W}{L})(V_{gs} - V_T - V_d)$	$\frac{\partial I_D}{\partial V_d} = \frac{1}{2}\lambda\mu C_{OX}(\frac{W}{L})(V_{gs} - V_T)^2$
	
	

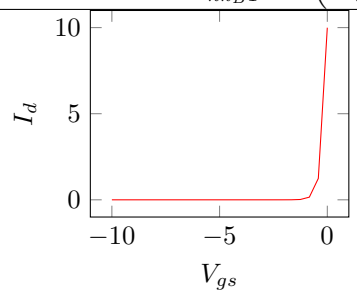
Problem - 3

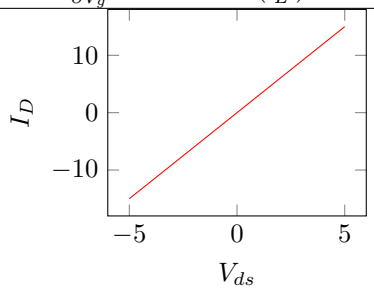
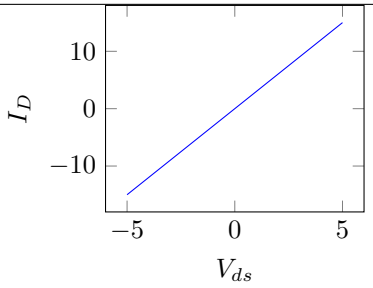
While $V_{gs} < V_T$,

$$I_{DS} = I_0 exp\left(\frac{q(V_{gs} - V_T)}{nk_BT}\right)\left(1 - exp\left(-\frac{qV_{ds}}{k_BT}\right)\right) \tag{4}$$

As $V_{ds} >> k_BT/q$

$$I_{DS} = I_0 exp\left(\frac{q(V_{gs} - V_T)}{nk_BT}\right)(1 - exp(-V_{ds})) \tag{5}$$

$V_{gs} < V_T$ (OFF conditions) and assume $V_{ds} >> k_BT/q$
$\frac{\partial I_{DS}}{\partial V_g} = I_0(1 - exp(-V_{ds}))\frac{q}{nk_BT}exp\left(\frac{q(V_{gs} - V_T)}{nk_BT}\right)$


<table>
<tr><td colspan="2">$V_{gs} > V_T$ (ON conditions)</td></tr>
<tr><td>Linear operation</td><td>Saturation operation</td></tr>
<tr><td>$\frac{\partial I_{DS}}{\partial V_g} = \mu C_{ox} V_{ds} \left(\frac{W}{L}\right)$</td><td>$\frac{\partial I_{DS}}{\partial V_g} = \mu C_{ox} \left(\frac{W}{L}\right) (V_{gs} - V_T)(1 + \lambda V_{ds})$</td></tr>
<tr><td> 
</td><td> 
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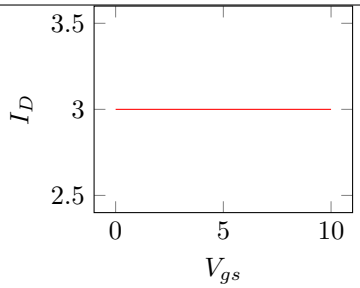
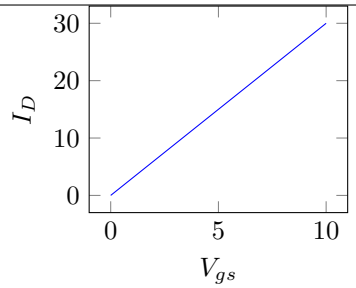
<tr><td> 
</td><td> 
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