CSE-411

Assignment-1

Group Number : 04

Section : B

Group members Roll numbers:

2017140 18

2017140 14

2017140 24

2017140 34

2017140 40

2015140 84

CSE-411

X = (Sum of all last two-digits of the roll numbers) MOD 7

= (18+14+24+34+40+84) MOD 7

= 214 mod 7

= 4

Y = (square(X) mod 3) + 1

= (16 mod 3) + 1

= 1 + 1

= 2

Z = (X + 2*Y) MOD 7 + 1

= (4+4) MOD 7 + 1

= 8 MOD 7 + 1

= 1 + 1

= 2

① Find out the value of R in a NMOS inverter with resistive load, having

$$\varepsilon\mu_n/D = (25+X)\,\mu A/V^2,$$

$$\frac{W}{L} = Y,$$

$$V_{ds} = 0.2V$$

Ans:

Given,

$$X = 4$$

$$Y = 2$$

$$Z = 2$$

$$\therefore \frac{\varepsilon\mu_n}{D} = (25+4) = 29 \ \mu A/V^2$$

$$\therefore \frac{W}{L} = 2$$

$$\therefore V_{ds} = 0.2V$$

We know,

$$V_p = 5V$$

$$V_{gs} = 5V$$

P.T.O.

$$I_{ds} = \frac{\epsilon W \mu}{D} \times \left(\frac{W}{L}\right) \times \left[(V_{gs} - V_t) V_{ds} - \frac{V_{ds}^2}{2}\right]$$

$$= 29 \times 2 \times \left[(5-1) 0.2 - \frac{(0.2)^2}{2}\right]$$

$$= 29 \times 2 \left[4 \times 0.2 - \frac{(0.2)^2}{2}\right]$$

$$= 29 \times 2 \times 0.78$$

$$= 45.24 \ \mu A$$

$$\therefore R = \frac{V_p - V_{ds}}{I_{ds}}$$

$$= \frac{5 - 0.2}{45.24 \times 10^{-6}}$$

$$= 106100.7958 \ \Omega$$

$$= 106.1 \ K\Omega$$

(Ans)

(2) Draw the I_{ds} vs V_{ds} curve, for N-channel enhancement type MOS, having

$$\frac{\varepsilon \mu_n}{D} = (24+X)\ \mu A/V^2,$$

$$\frac{W}{L} = Y+1,$$

$$V_t = 1\ V$$

for, $V_{gs} = 5, 4, 3, 2$ volts.

Ans: Given,

$X = 4$

$Y = 2$

$Z = 2$

$\therefore \frac{\varepsilon \mu_n}{D} = 24+4 = 28\ \mu A/V^2$

$\therefore \frac{W}{L} = 2+1 = 3$

$\therefore V_t = 1\ V$

$\therefore V_{gs} = 5, 4, 3, 2$

P.T.O.

V_{gs}	V_{ds} $(V_{gs}-V_t)$	$(V_{gs}-V_t)^2$	$I_{ds(sat)} = \frac{\varepsilon \mu n}{D} \times \frac{W}{L} \times \frac{(V_{gs}-V_t)^2}{2}$
5	4	16	672
4	3	9	378
3	2	4	168
2	1	1	42

I_{ds} Vs V_{ds} curve for N-channel enhancement type MOS is shown below:

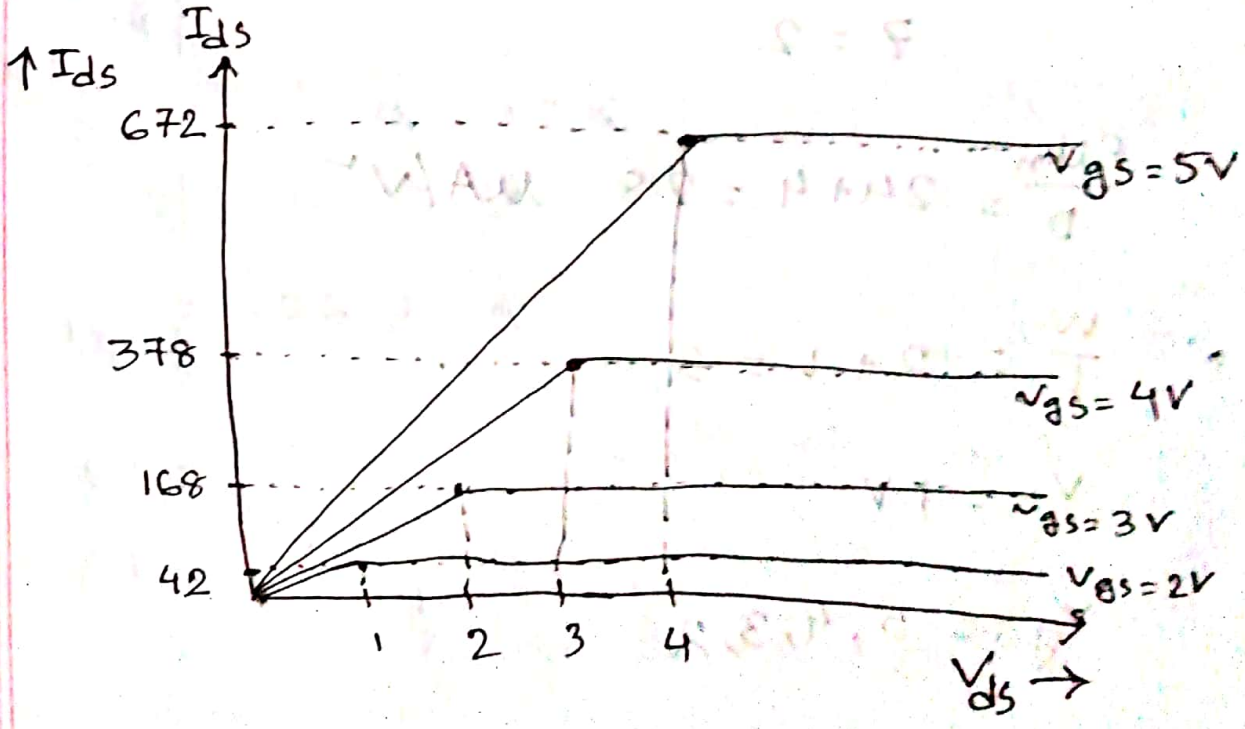

Fig: (I_{ds} Vs V_{ds}) curve.

③ Draw the I_{sd} Vs V_{sd} curve for P-channel enhancement type MOS, having

$$\frac{\varepsilon \mu_p}{D} = (12+Z)\ \mu A/V^2,$$

$$\frac{W}{L} = Y+1,$$

$$V_{tp} = 1V$$

for, $V_{sg} = 5, 4, 3, 2$ volts.

Ans: Given,

$X = 4$

$Y = 2$

$Z = 2$

$\therefore \frac{\varepsilon \mu_p}{D} = 12+2 = 14\ \mu A/V^2$

$\therefore \frac{W}{L} = 2+1 = 3$

$\therefore V_{tp} = 1V$

$\therefore V_{sg} = 5, 4, 3, 2$ volts.

V_{sg}	V_{sd} $(V_{sg} - V_{tp})$	$(V_{sg} - V_{tp})^2$	$I_{sd}(sat) = \frac{\varepsilon \mu_p}{D} \times \frac{W}{L} \times \frac{(V_{sg} - V_{tp})^2}{2}$
5	4	16	336
4	3	9	189
3	2	4	84
2	1	1	21

∴ I_{sd} vs V_{sd} curve for P-channel enhancement typemos is drawn below:

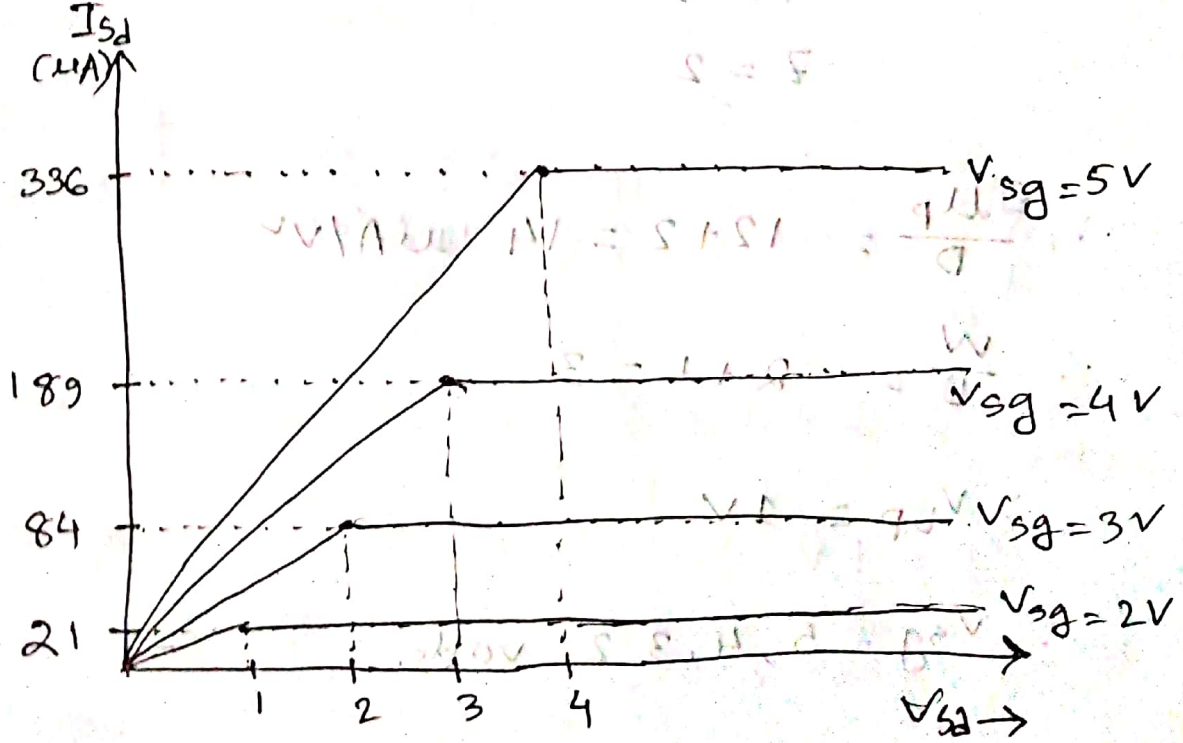

Fig: (I_{sd} Vs V_{sd}) curve