1.(需說明原因與產生的影響)

(a) **參考講義 2-66**

(b) **參考講義 2-62**

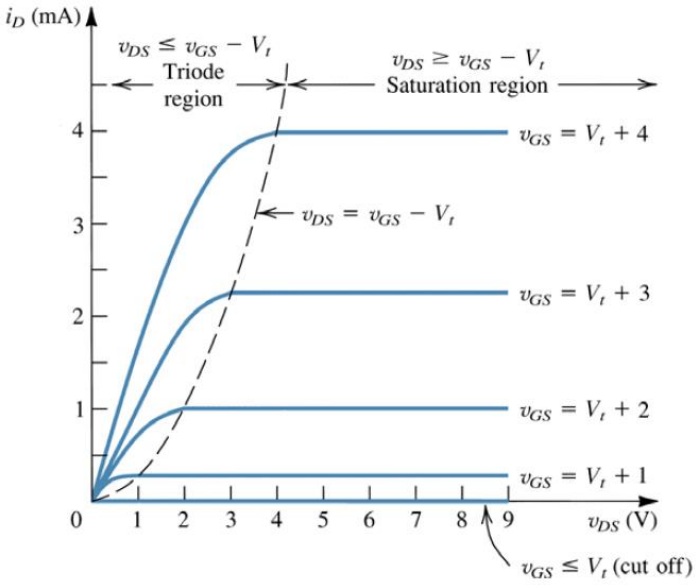
(c) **參考講義 2-39**

(d) **參考講義 2-33**

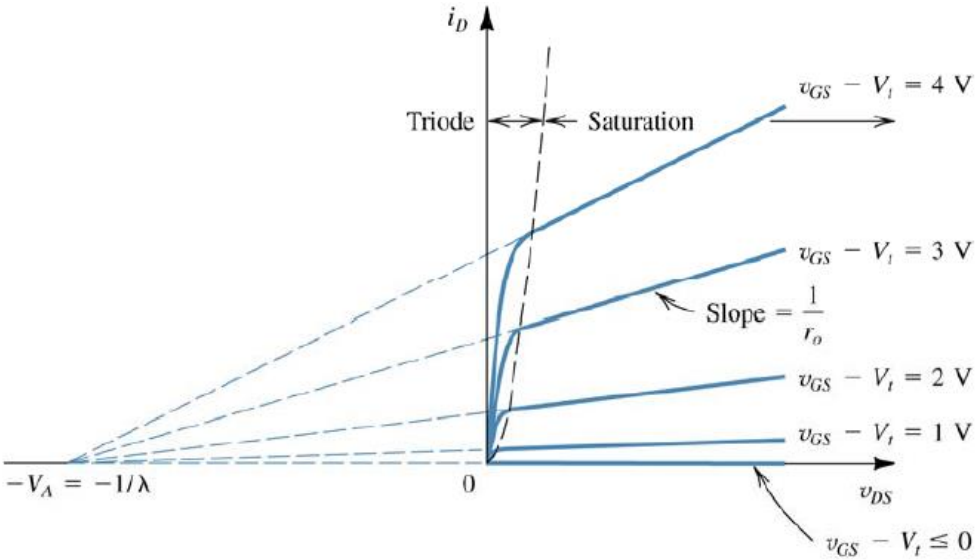
(e) **參考講義 2-63~65**

2.

(a)(b)(d)



(c)



3.

(a)

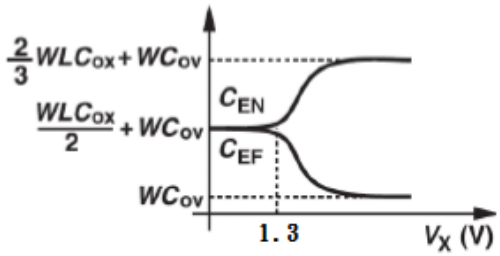
0V≦Vx≦1.3V triode

CEF=CEN = 1/2WLCox + WCov = 6fF

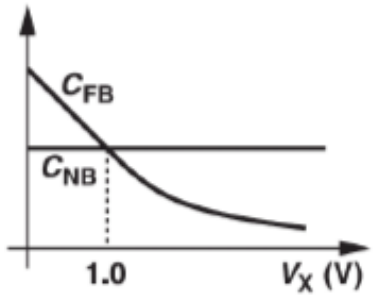
1.3V≦Vx≦3V saturation

CEF = WCov = 1fF

CEN = 2/3WLCox + WCov = 7.67fF

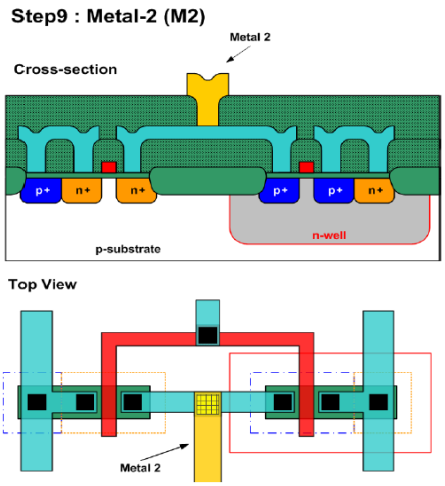


(b)



4. **參考講義 1-70~79**

(a)

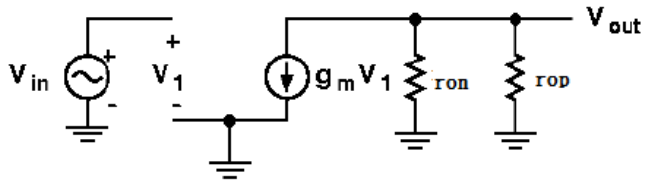


(b)

p-sub => 1. NW 2.OD 3. PO 4.PP 5.NP 6.CO 7.M1 8.Via1 9.M2

5.

(a)

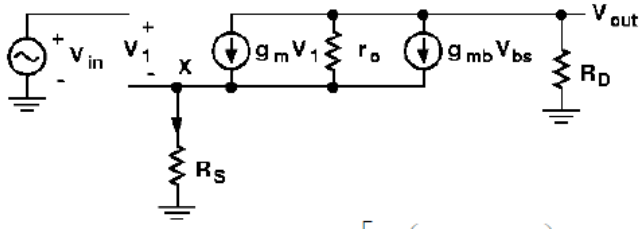


(b)

Av= -gm<n>(ron//rop)

6.

(a) gmb = 0



(b)

$$R_{out} = \left[1 + g_m r_o\right] R_S + r_o$$

$$= 1.2\text{M}\Omega$$

7.

Triode region:

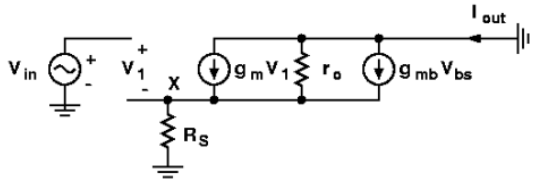
$$I_D = \mu C_{ox} \frac{W}{L}[(V_{GS} - V_{TH})V_{DS} - \frac{1}{2}V_{DS}{}^2]$$

Saturation region:

$$I_D = \frac{1}{2}\mu_n C_{ox} \frac{W}{L}(V_{GS} - V_{TH})^2(1 + \lambda V_{DS})$$

8.

(a)



(b)

$$A_v = \frac{V_{out}}{V_{in}} = \frac{g_m R_S}{1+(g_m+g_{mb})R_S}$$

= 0.83V/V

9. (方向錯誤,沒寫單位:0 分)

(a) $A_{v.DM} = -g_m(R_D \| r_O)$=-133V/V

(b)

$$A_{v,CM} = \frac{V_{out}}{V_{in,CM}} = -\frac{R_D/2}{1/(2g_m)+R_{SS}}$$

=-0.24 V/V

(c)

$$\Delta V_{in} = \sqrt{2I_{SS}/(\mu_n C_{ox} W/L)}$$

=283mV

(d)

$$V_{GS1}+(V_{GS3}-V_{TH3}) \le V_{in,CM} \le \min\left[V_{DD}-R_D\frac{I_{SS}}{2}+V_{TH}, V_{DD}\right]$$

1V < $V_{in,CM}$ < 1.4V

10.

(a)

$$\frac{I_{D2}}{I_{D1}} = \frac{(W/L)_2}{(W/L)_1}\frac{1+\lambda V_{DS2}}{1+\lambda V_{DS1}}$$

V_{DS2}=0.5V,V_{DS1}=0.7V,I_{out}=39.842uA

(b) Vout > Vov=0.2V

11.

(a) Vb = Vth +2Vov =0.9V

Vout = 2Vov=0.4V

(b) $(W/L)_5$=0.25*$(W/L)_1$= 0.5um/4um

(只寫 ratio: 0 分)

12. (gain 算成-200V/V or 沒寫單位:0 分)

(a)

$$A_v = -g_m(R_D \| r_o) = -100V/V$$

$$C_{in} = C_{GS} + C_{GD}(1 - A_v) = 510\,fF (\approx 505\,fF)$$

$$C_{out} = C_{DB} + C_{GD}(1 - \frac{1}{A_v}) = 7.05\,fF (\approx 7\,fF)$$

(b)

$$\omega_{in} = \frac{1}{R_{in} \cdot C_{in}} = \frac{1}{R_s \cdot C_{in}} = 1.96 \times 10^8 rad/\sec$$

$$\omega_{out} = \frac{1}{R_{out} \cdot C_{out}} = \frac{1}{(R_D \| r_o) \cdot C_{out}} = 2.84 \times 10^9 rad/\sec$$

13.

(a) (方向錯誤:0 分)

$$V_{in,\min} = V_{ov5} + V_{GS1} = 2V_{ov} + V_{th} = 1V$$

(b)

$$\max.\, swing = V_{DD} - V_{ov4} - V_{ov2} - V_{ov5} = 1.2V$$

(c)

$$V_{out}/(V_{in1} - V_{in2}) = g_m(r_{o4} \| r_{o2}) = 50V/V$$

(d)

$$CMRR = \frac{A_{v,DM}}{A_{v,CM}} = \frac{g_m(r_o \| r_o)}{\frac{1}{2g_m r_o}} = (g_m r_o)^2 = 10000$$

14.

(a) F, before →after

(b) T

(c) T

(d) T, C_j is proportional to A, where A is width*depth

(e) T

(f) F, low power → double power

(g) F, $I \uparrow, V_{ov} \uparrow, swing \downarrow$

(h) F, chemical vapor deposition→photolithography

(i) F, $g_m = \sqrt{2\beta I}$, proportional to square root of width

(j) F, larger→smaller, because mobility $\mu_p < \mu_n$

(k)T

(l) T

(m) F, after 0hz→after pole frequency

(n) F, voltage swing is decreased

(o) F, length modulation effect→impact ionization