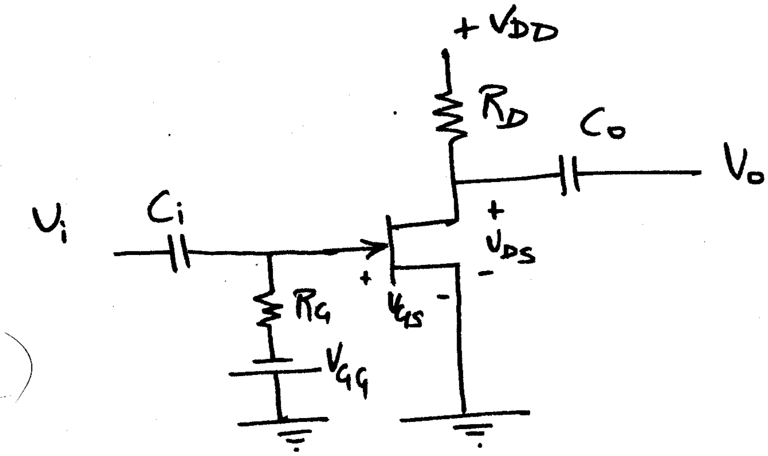
JFET BIASING

TYPE I : FIXED BIAS



Applying KUL to GS loop:

$$-V_{GG} - I_G R_G - V_{GS} = 0$$

$$\boxed{V_{GS} = -V_{GG}} \quad [\because I_G = 0]$$

By Shockley's equation

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

$$= \_\_\_\_\_\_$$

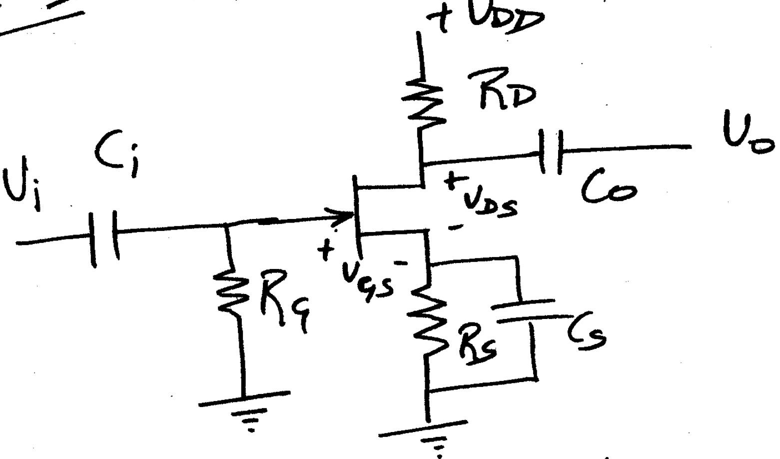
Applying KUL to D-S loop

$$V_{DD} - I_D R_D - V_{DS} = 0$$

$$V_{DS} = V_{DD} - I_D R_D$$

$$= \_\_\_\_\_\_\_\_$$

TYPE II : SELF BIAS



Applying KVL to G-S loop

$$-V_{GS} - I_D R_S = 0$$

$$V_{GS} = -I_D R_S \quad \text{——— (i)}$$

By Shockley's equation

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2 \quad \text{——— (ii)}$$

Solving (i) & (ii) we get I_D & V_{GS}.

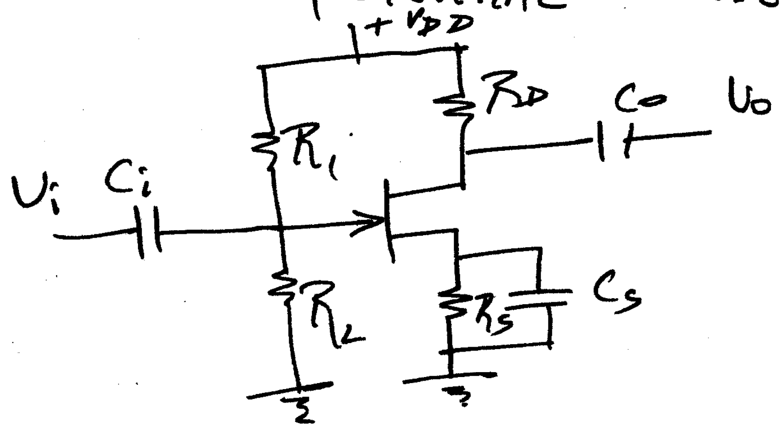
Applying KVL to D-S loop

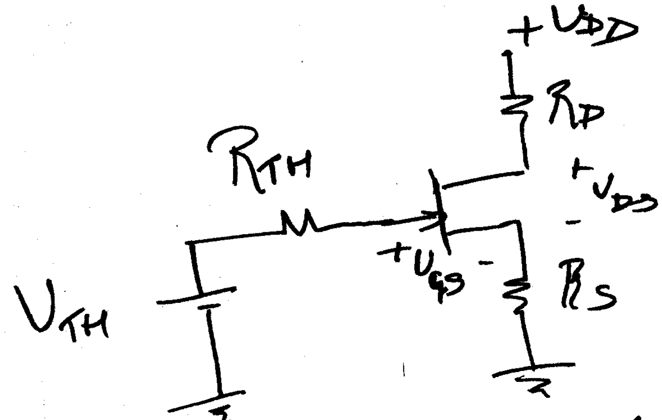
$$V_{DD} - I_D R_D - V_{DS} - I_D R_S = 0$$

$$V_{DS} = V_{DD} - I_D R_D - I_D R_S$$

$$= \_\_\_\_\_\_\_\_ .$$

TYPE III : VOLTAGE DIVIDER BIAS / POTENTIAL DIVIDER BIAS





$$R_{TH} = R_1 \parallel R_2$$

$$V_{TH} = \frac{R_2}{R_1 + R_2} V_{DD}$$

Applying KVL to G-S loop

$$V_{TH} - V_{GS} - I_D R_S = 0 \quad \text{—(i)}$$

By Shockley's equation

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2 \quad \text{—(ii)}$$

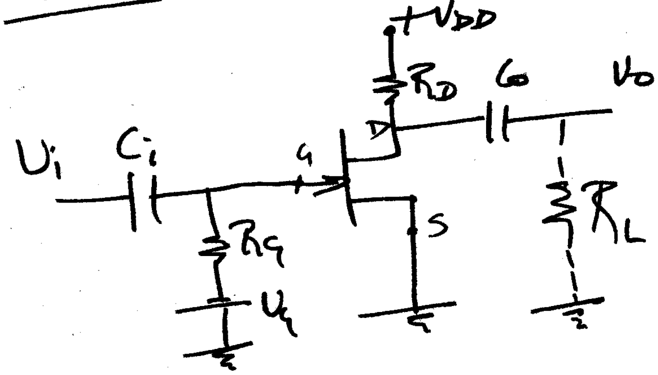
Solve (i) & (ii) & get I_D & V_{GS}

KVL to D-S loop $V_{DD} - I_D R_D - V_{DS} - I_D R_S = 0$

$V_{DS} =$ ______

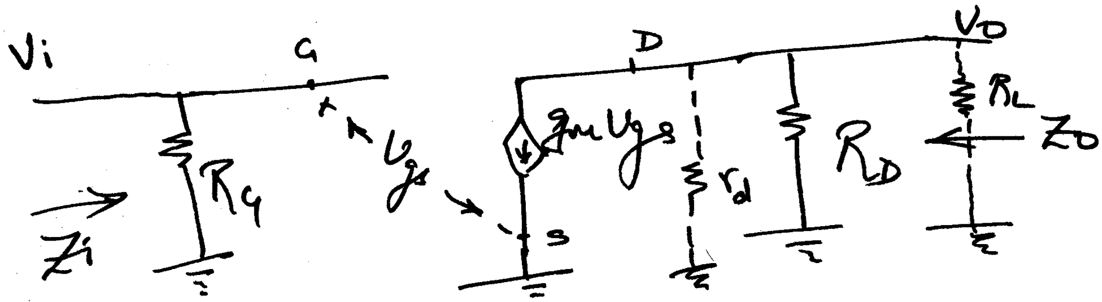
JFET A.C. ANALYSIS

TYPE I : FIXED BIAS



$$g_{m0} = \frac{2 I_{DSS}}{|V_P|}$$

$$g_m = g_{m0}\left(1 - \frac{V_{GS}}{V_P}\right)$$



$$Z_i = R_G$$

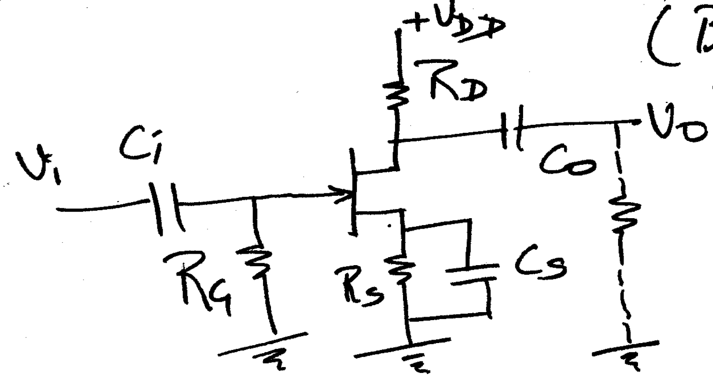
$$Z_o = r_d \| R_D$$

$$A_v = \frac{V_o}{V_i} = \frac{-g_m V_{gs} (r_d \| R_D \| R_L)}{V_{gs}}$$

$$= -g_m (r_d \| R_D \| R_L)$$

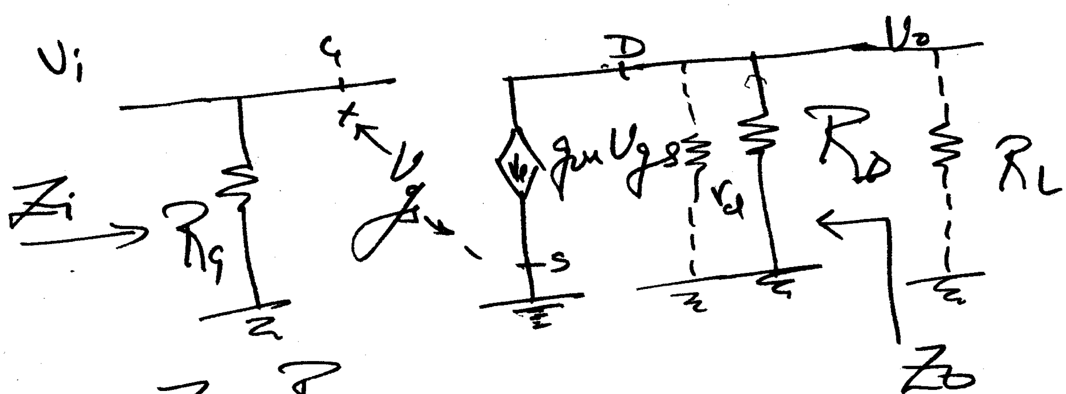
TYPE II: (A) SELF BIAS

(Bypass R_S)



$$g_{m0} = \frac{2 I_{DSS}}{|V_P|}$$

$$g_m = g_{m0}\left(1 - \frac{V_{GS}}{V_P}\right)$$



$$Z_i = R_G$$

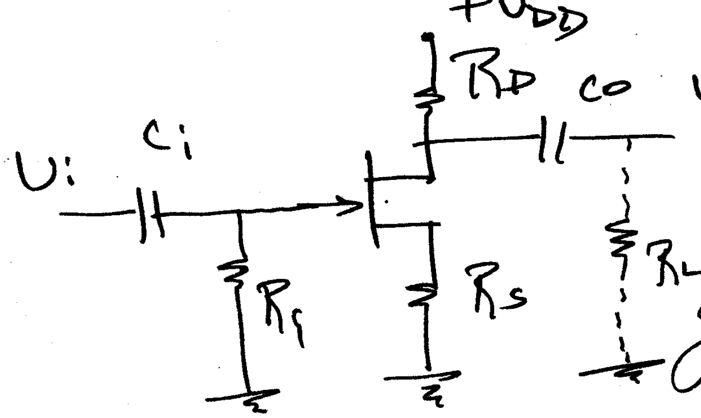
$$Z_o = R_D \| r_d$$

$$A_V = \frac{-g_m \cancel{V_{gs}} (r_d \| R_D \| R_L)}{\cancel{V_{gs}}}$$

$$= -g_m (r_d \| R_D \| R_L)$$

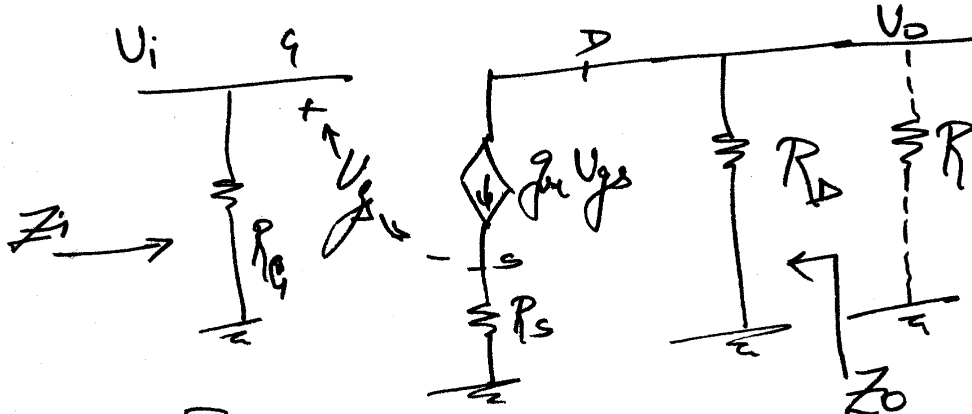
TYPE II : (B) SELF BIAS (UNBYPASSED R_S)

($r_d = \infty \Omega$)



$$g_{m0} = \frac{2 I_{DSS}}{|V_P|}$$

$$g_m = g_{m0}\left(1 - \frac{V_{GS}}{V_P}\right)$$

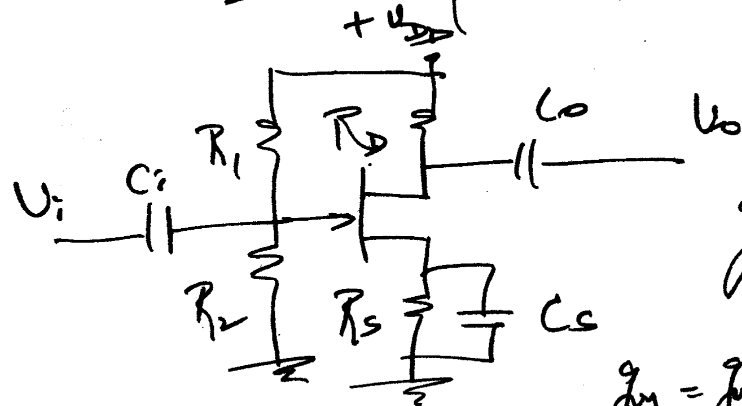


$Z_i = R_g \qquad Z_o = R_D$

$$A_V = \frac{-g_m V_{gs} (R_D \| R_L)}{V_{gs} + g_m V_{gs} R_s}$$

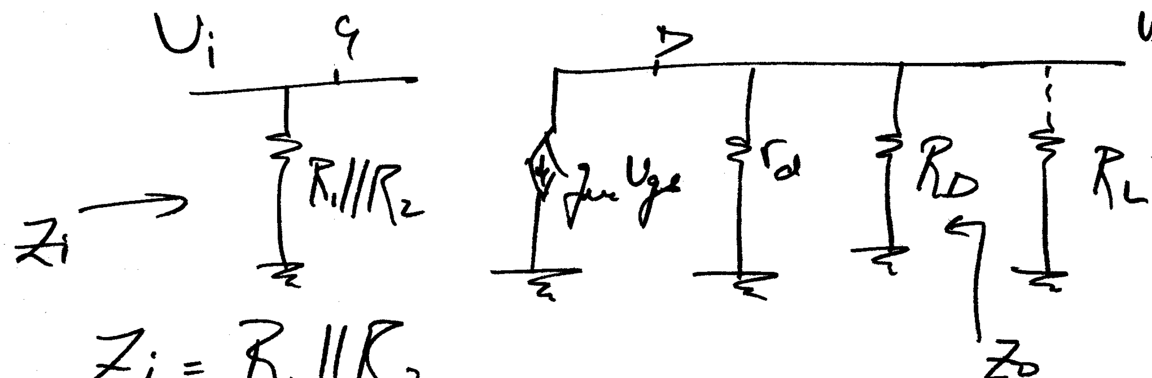
$$= \frac{-g_m (R_D \| R_L)}{1 + g_m R_s}$$

TYPE III : VOLTAGE DIVIDER / POTENTIAL DIVIDER BIAS



$$g_{m0} = \frac{2I_{DSS}}{|V_p|}$$

$$g_m = g_{m0}\left(1 - \frac{V_{GS}}{V_p}\right)$$



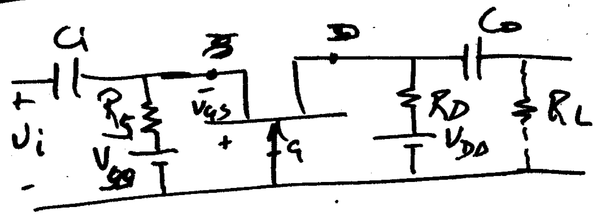
$$Z_i = R_1 \parallel R_2$$

$$Z_o = r_d \parallel R_D$$

$$A_V = \frac{-g_m V_{gs}(r_d \parallel R_D \parallel R_L)}{V_{gs}}$$

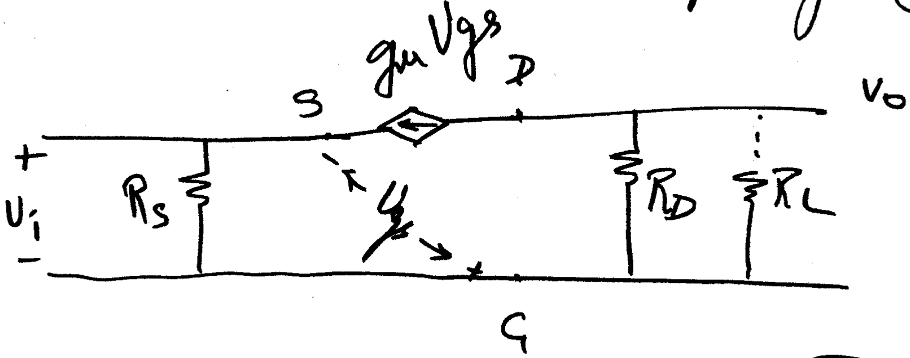
$$= -g_m (r_d \parallel R_D \parallel R_L)$$

TYPE IV : COMMON GATE



$$g_{m0} = \frac{2 I_{DSS}}{|V_p|}$$

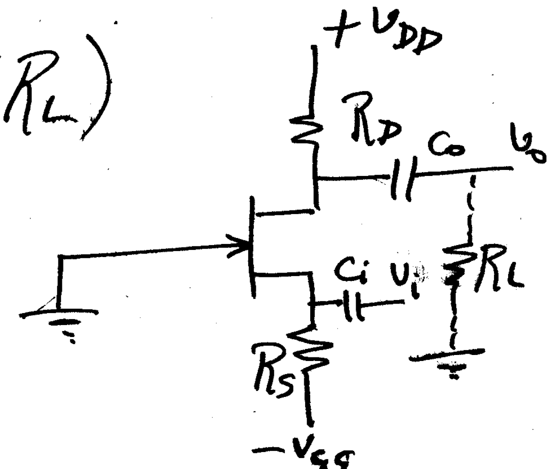
$$g_m = g_{m0}\left(1 - \frac{V_{GS}}{V_p}\right)$$



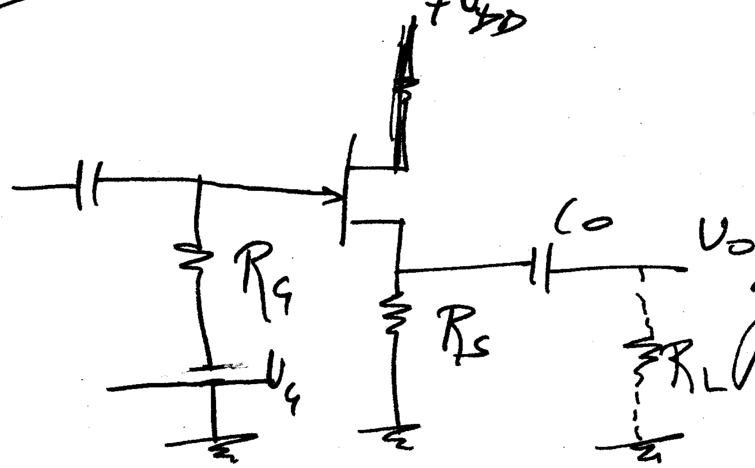
$$Z_i = R_S \parallel 1/g_m \qquad Z_o = R_D$$

$$A_v = \frac{+g_m V_{gs}(R_D \parallel R_L)}{+V_{gs}}$$

$$= g_m (R_D \parallel R_L)$$

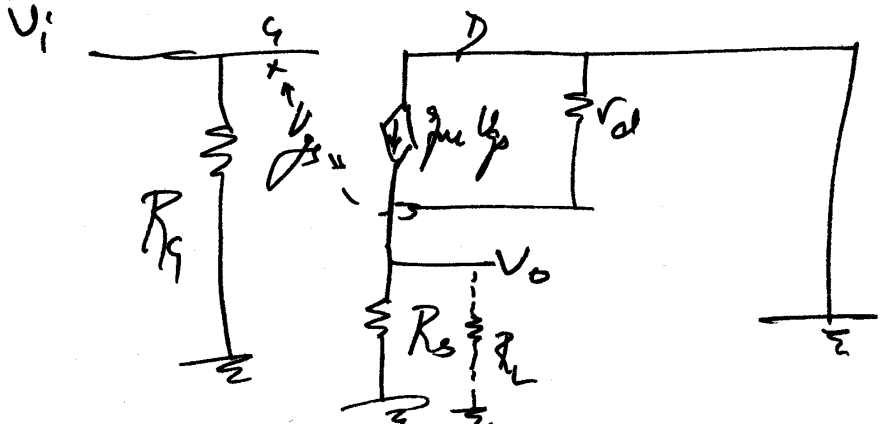


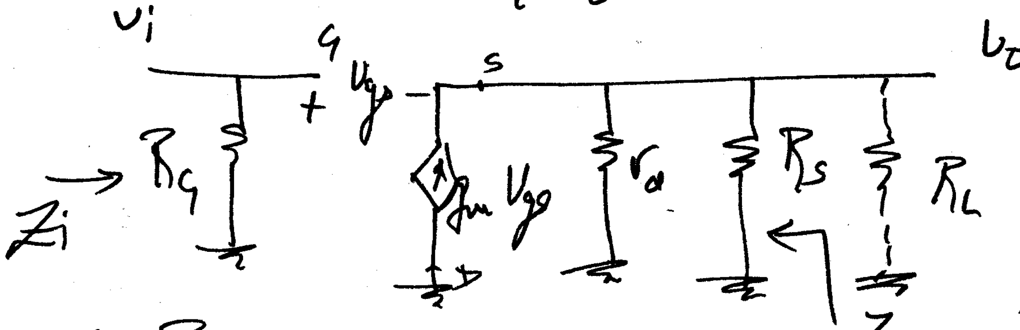
TYPE V : COMMON DRAIN



$$g_{m_0} = \frac{2 I_{DSS}}{|V_P|}$$

$$g_m = g_{m_0}\left(1 - \frac{V_{GS}}{V_P}\right)$$





$$A_V = \frac{g_m (r_d \| R_S \| R_L)}{1 + g_m (r_d \| R_S \| R_L)}$$

$$Z_i = R_G$$

$$Z_o = r_d \| R_S \| 1/g_m$$

$$A_v = \frac{g_m V_{gs} (r_d \| R_S \| R_L)}{V_{gs} + g_m V_{gs} (r_d \| R_S \| R_L)}$$