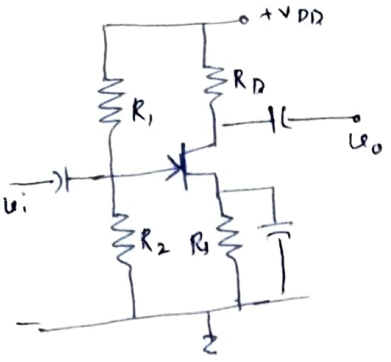
Voltage-Divider Bias



$$V_G = \frac{R_2 \cdot V_{DD}}{R_1 + R_2}$$

$$V_{GS} = V_G - V_S$$

$$= V_G - I_D R_S$$

$$V_{DS} = V_{DD} - I_D (R_D + R_S)$$

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

Given $V_{DD} = 22V$, $R_1 = 850k\Omega$, $R_2 = 330 k\Omega$, $R_D = 2.2k$, $R_S = 1.8 k\Omega$.

$I_{DM} = 8mA$, $V_P = -4V$

$$V_G = V_{DD} \cdot \frac{R_2}{R_1 + R_2} = 6V \; ; \quad V_{GS} = V_G - V_S = 6 - I_D \times 1.8K.$$

$$I_D = I_{DM}\left(1 - \frac{V_{GS}}{V_P}\right)^2 = 8\left(1 - \frac{6 - 1.8 I_D}{-4}\right)^2$$

$I_{D1} = 3.95mA \rightarrow V_{GS1} = -1.16V$ ✓

$I_{D2} = 7.7mA \rightarrow V_{GS2} = -7.86V$ ✗

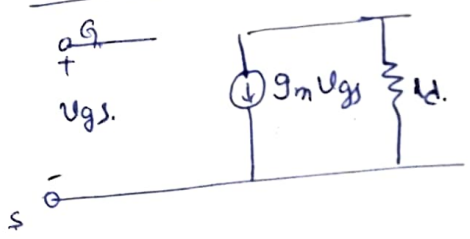
$$V_S = I_D R_S = 3.98 \times 1.8 = 7.16V$$

$$V_D = V_{DD} - I_D R_D = 22 - (3.98m)(2.2k)$$

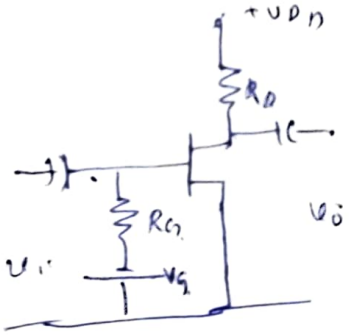
$$= 13.24V$$

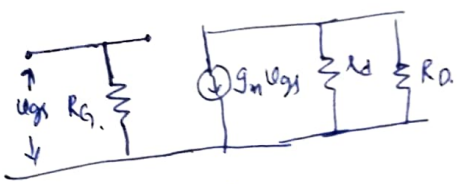
$$V_{DS} = V_D - V_S = 13.24 - 7.16 = 6V$$

Small signal model



Common Source Amp





$$R_i = R_G$$

$$R_o = R_d \| R_D$$

$$A_v = \frac{v_o}{v_i} = \frac{-g_m v_{gs}(R_d \| R_D)}{v_{gs}}$$

$$= -g_m (R_d \| R_D)$$