

Soru-1 Şekildeki devrede kullanılan MOS tranzistör için $\beta = 4 \text{ mA/V}^2$, $V_{TH} = 1 \text{ V}$ ve $V_A = 50 \text{ V}$ değerleri verilmektedir.
a) MOS tranzistör doymada olduğuna göre R_S direncinin değerini bulunuz. (30 Puan)

$$I_D = \frac{\beta}{2} (V_{GS} - V_{TH})^2 \quad (1 + \frac{V_{DS}}{V_A}) \quad V_{GD} < V_{TH}$$

$$2 \text{ mA} = \frac{4 \text{ mA}}{2 \text{ V}^2} (V_{GS} - 1)^2$$

$$1 = (V_{GS} - 1)^2$$

$$V_{GS} - 1 = 1$$

$$\underline{V_{GS} = 2 \text{ V}}$$

$$V_{DD} - I(R_1 + R_2) = 0$$

$$9 \text{ V} - I(600 \text{ k} + 300 \text{ k}) = 0$$

$$I = 0,01 \text{ mA}$$

$$V_G = R_2 I = (300 \text{ k})(0,01 \text{ mA}) = 3 \text{ V}$$

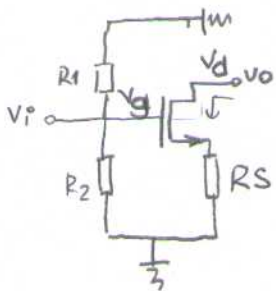
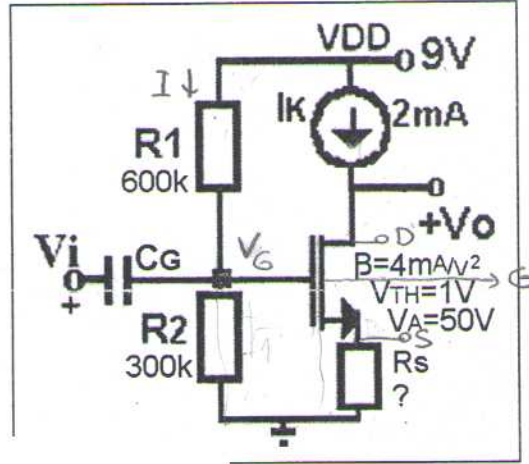
$$V_G - V_{GS} - I_D R_S = 0$$

$$3 - 2 \text{ V} - (2 \text{ mA}) R_S = 0$$

$$1 \text{ V} = 2 \text{ mA } R_S$$

$$R_S = 0,5 \text{ k} = 500 \, \Omega$$

b) Devrenin ac v_o/v_i kazancını bulunuz. (70 Puan)



$$\frac{v_d}{v_g} = \frac{-g_m R_d}{1 + g_m R_S}$$

$$R_d = r_d = r_{ds} \left(g_m R_S + \frac{R_S}{r_{ds}} + 1 \right)$$

$$r_{ds} = \frac{V_A}{I_{DQ}} = \frac{50 \text{ V}}{2 \text{ mA}} = 25 \text{ k}$$

$$R_d = (25 \text{ k}) \left(\frac{4 \text{ mA}}{\text{V}} \cdot 0,5 \text{ k} + \frac{0,5 \text{ k}}{25 \text{ k}} + 1 \right)$$

$$R_d = 75,5 \text{ k}$$

$$g_m = \sqrt{2 \beta I_{DQ}} \quad 2 \text{ mA}$$

$$g_m = \sqrt{2 \left(\frac{4 \text{ mA}}{\text{V}^2} \right) 2 \text{ mA}}$$

$$g_m = 4 \frac{\text{mA}}{\text{V}}$$

$$\frac{v_o}{v_i} = \frac{v_d}{v_g} = - \frac{\frac{4 \text{ mA}}{\text{V}} \cdot 75,5 \text{ k}}{1 + \frac{4 \text{ mA}}{\text{V}} \cdot 0,5 \text{ k}} \approx -100$$