ECE 342
Electronic Circuits

Lecture 12
Common Source Amplifiers - 4

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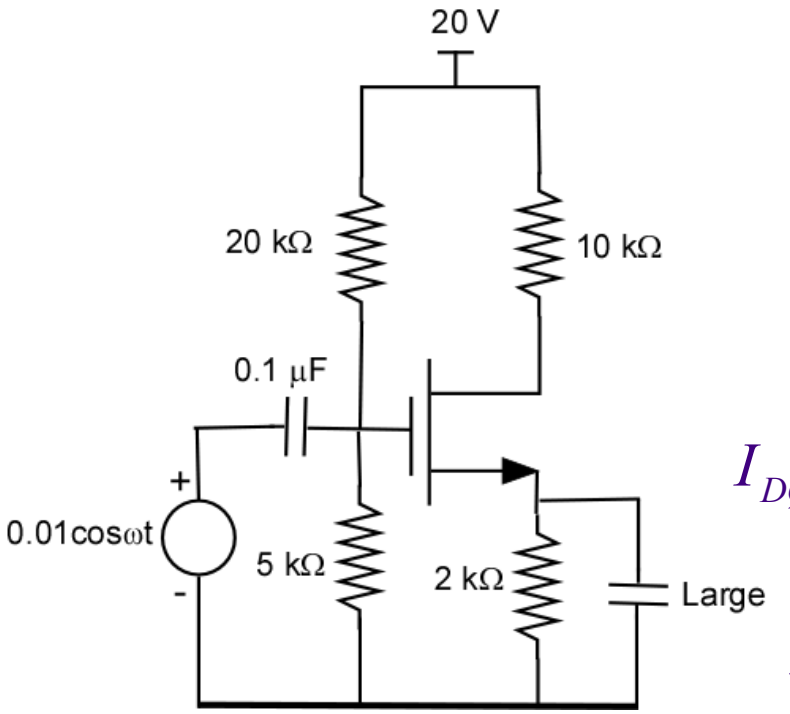
Example

For the circuit shown, $K = k_n/2 = \mu C_{ox}(W/2L) = 75\ \mu A/V^2$, $V_T = 1\ V$, $\lambda = 0$

(a) Find V_{DQ}, V_{SQ}

(b) Find the midband gain



$$V_{GQ} = V_{DD}\frac{R_2}{R_1 + R_2} = \frac{20 \times 5}{25} = 4\,V$$

$$V_{GSQ} = V_{GQ} - V_{SQ} = 4 - 2I_{DQ}$$

$$I_{DQ} = K\left[V_{GSQ} - V_T\right]^2 = 0.075\left[4 - 2I_{DQ} - 1\right]^2$$

$$I_{DQ} = 0.075(9 - 12I_{DQ} + 4I_{DQ}^2)$$

$$4I_{DQ}^2 - 12I_{DQ} + 9 = 13.3I_{DQ} \Rightarrow I_{DQ}^2 - 6.33I_{DQ} + 2.25 = 0$$

Example (Cont')

$$I_{DQ} = 3.167 \pm \frac{\sqrt{6.33^2 - 9}}{2} = 0.378\ mA \text{ or } 5.953\ mA$$

reject since voltage drop across R_D will be too large

$$I_{DQ} = 0.378\ mA$$

$$V_{DQ} = V_{DD} - R_D I_{DQ} = 20 - 10 \times 0.378 = 16.22\ V$$

$$V_{SQ} = R_S I_{DQ} = 2 \times 0.378 = 0.756\ V$$

$$V_{DQ} = 16.22\ V$$

$$V_{SQ} = 0.756\ V$$

Example (Cont')

$$g_m = \sqrt{2k_n' \frac{W}{L} I_{DQ}} = \sqrt{4 \times 0.075 \times 0.378} = 0.337\ mA/V$$

$$A_{MB} = -g_m R_D = -0.337 \times 10 = -3.37$$

$$\boxed{A_{MB} = -3.37}$$