Correction to Answer for Common-Source Amplifier Example

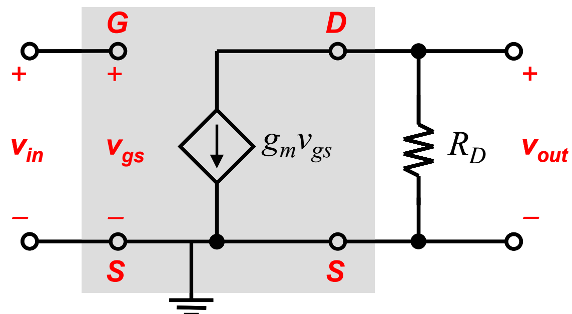
Part (f): This problem was a bit "trickier" than originally intended!

For $R_D =$ 25 kΩ, the MOSFET would be operating in the *linear region*, with $v_{DS} = v_{OUT} =$ 0.5 V. (This is obtained by load-line analysis, *i.e.* carefully sketching the i_D-v_{DS} curve for $v_{GS} = 3$ V, then sketching the load line, then finding the value of v_{DS} at the point where these curves intersect.) The formula for g_m is then

$$g_m \equiv \frac{\partial i_D}{\partial v_{GS}}\bigg|_{v_{GS}=3V} = \frac{\partial}{\partial v_{GS}}\left[k'\frac{W}{L}\left(v_{GS} - V_T - \frac{v_{DS}}{2}\right)v_{DS}\right]\bigg|_{v_{GS}=3V}$$

$$= k'\frac{W}{L}v_{DS} = 50\times10^{-6}(3)(0.5) = 7.5\times10^{-5}\,S$$

The small-signal equivalent circuit for the amplifier is



From this circuit, it can be seen that the incremental change in the output voltage, v_{out}, is simply $-g_m v_{gs} R_D = -(7.5\times10^{-5})(0.1)(25000) = 0.1875$ V. This is larger than the value of 0.15 V which we obtained for $R_D = 5$ kΩ.

RL Circuit Answer

$t < 0$: $v = 2$ V

$t > 0$: $v = 10 - 8e^{-1000t}$

(Note that v is a continuous function of time, because the current flowing through the inductor is a continuous function of time.)

RC Circuit Answer

$t < 0$: $v = 0$ V

$t > 0$: $v = -1.5e^{-100t}$ Volts

(Note that v is discontinuous at $t = 0$.)

Diode Circuit #1 (left) Answer

D1 is ON ($V_{D1} = 0$, $I_{D1} > 0$; *i.e.* short circuit with positive current flow)

D2 is OFF ($V_{D2} < 0$, $I_{D2} = 0$; *i.e.* open circuit with negative voltage drop)

$V = 6$ V; $I = 6$ mA

Diode Circuit #2 (right) Answer

D1 is ON ($V_{D1} = 0$, $I_{D1} > 0$; *i.e.* short circuit with positive current flow)

D2 is OFF ($V_{D2} < 0$, $I_{D2} = 0$; *i.e.* open circuit with negative voltage drop)

$V = 10$ V; $I = 0$