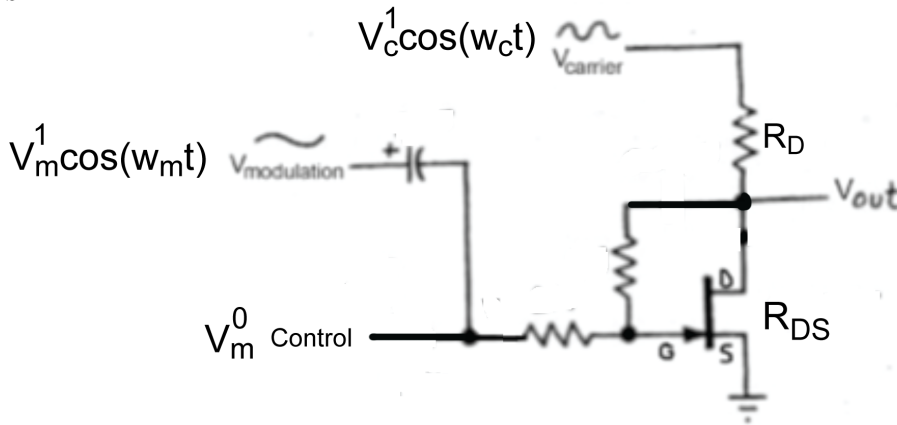


Physics 120 - HW 6 - Spring 2019

Laboratory exercise 6.3 involves a modulated carrier signal, with frequencies ω_c and ω_m . The goal is to produce an output signal of the form $\cos(\omega_c t)\cos(\omega_m t)$. The circuit can be recast as a voltage divider, with the FET acting as one resistor, i.e., R_{DS} .



Work out an expression for the output of this circuit that has leading terms proportional to $\cos(\omega_c t)$ and to the product $\cos(\omega_c t)\cos(\omega_m t)$. The solution will be in terms of the variables R_D , I_{DSSS} , $V_{GS}(\text{off})$, the carrier input $V_{carrier} = V_c^1 \cos(\omega_c t)$, and the modulatory input $V_{mod} = V_m^0 + V_m^1 \cos(\omega_m t)$.

Identify a small dimensionless parameter for the expansion. In this regard, $R_D = 10 \text{ k}\Omega$, $I_{DSSS} \approx 10 \text{ mA}$, and $V_{GS}(\text{off}) \approx -4 \text{ V}$. Also mind the size of V_m^1 .

As a hint, your answer should be of the form

$$V_{out} \approx A \cos(\omega_c t) + B \frac{V_m^1}{V_{GS}(\text{off})} \cos(\omega_c t) \cos(\omega_m t). \quad (0.1)$$