Electronics II, Exam-2, Spring 2020

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May 8, 2020, Dr. Dah-Chung Chang (E1-311)

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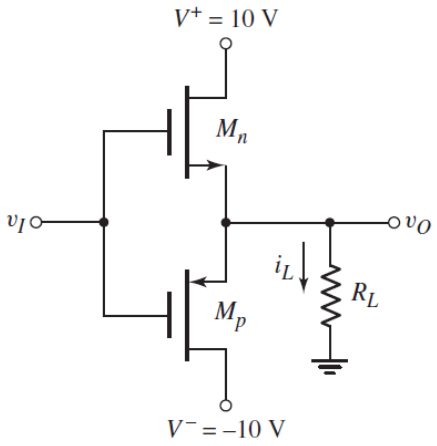
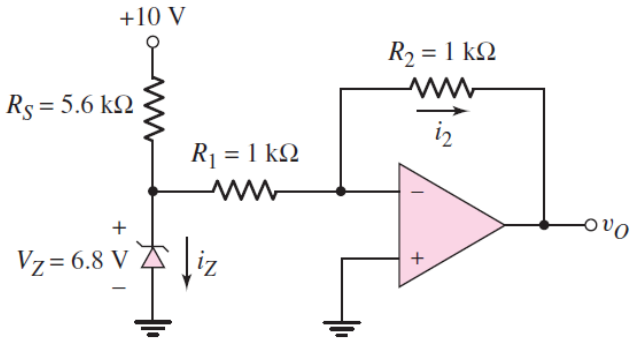
1. (10%) A power BJT must dissipate 30 W of power. The maximum allowed junction temperature is $T_{j,max}=150^{\circ}$ C, the ambient temperature is 25° C, and the device-to-case thermal resistance is $\theta_{\text{dev-case}}=2.8^{\circ}$ C/W.
   (a) Find the maximum permissible thermal resistance between the case and ambient.
   (b) Using the results of part (a), determine the junction temperature if the power dissipated in the transistor is 20 W.

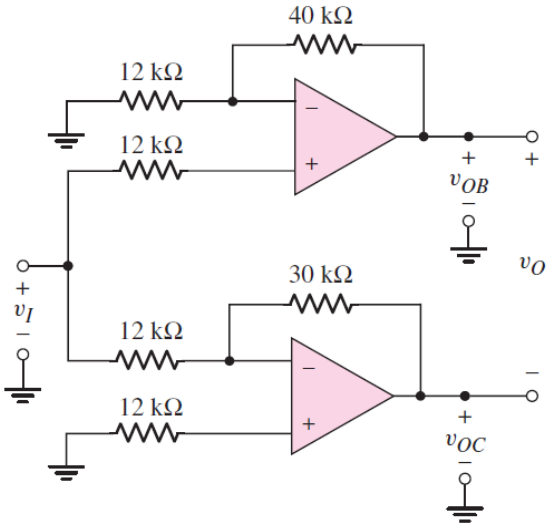
2. (30%) Consider the class-B output stage with complementary MOSFETs. The transistor parameters are $V_{\text{TN}}=V_{\text{TP}}=0$ and $K_n=K_p=0.4$ mA/V^2. Let $R_{\text{L}}=5\text{k}\Omega$.
   (a) Find the maximum output voltage such that *Mn* remains biased in the saturation region. What are the corresponding values of i_{L} and v_I for this condition?
   (b) Determine the conversion efficiency for a symmetrical sine-wave output signal with the peak value found in part (a).



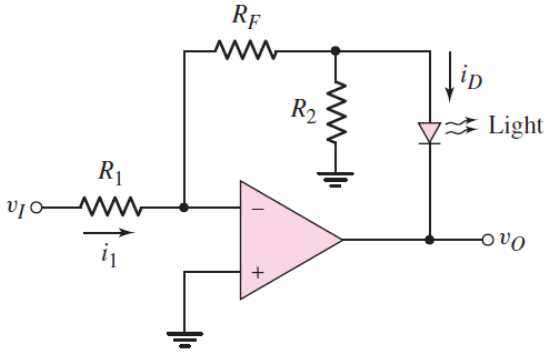
3. (15%) Assume that the breakdown voltage of the Zener diode is $V_Z=6.8$ V. Determine v_O, i_2, and i_Z.



4. (15%) What is the voltage gain v_O/v_I?



5. (10%) Derive the expression for i_D in terms of i_1 and resistors.



6. (20%) Assume that the breakdown voltage of the Zener diode is $v_Z = 5.6$ V. Find v_O in terms of δ.