Electronics II, EXAM-2, Spring 2024

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May 3, 2024, Prof. Dah-Chung Chang (E1-311)

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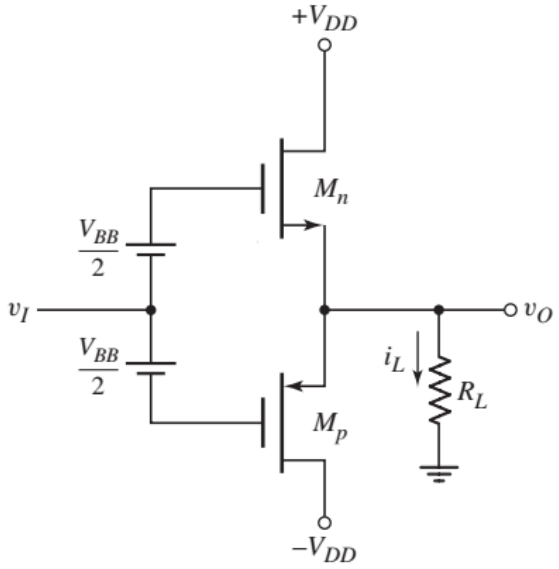
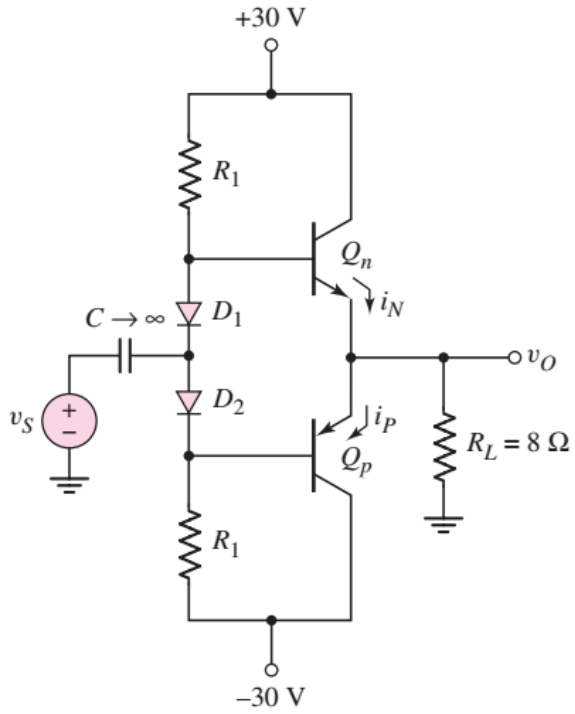
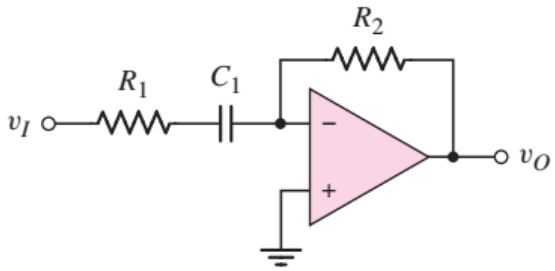
1. (20%) Assume that the conduction parameter in the MOSFET current-voltage characteristics is denoted by $K_n = K_p = K$. Show that the voltage gain for the class-AB output stage is $A_v = \frac{dv_O}{dv_I} = \frac{2\sqrt{KR_L}\sqrt{v_O}}{1+2\sqrt{KR_L}\sqrt{v_O}}$ when $v_I = +V_{DD}$ (that is, the transistor Mp is off).



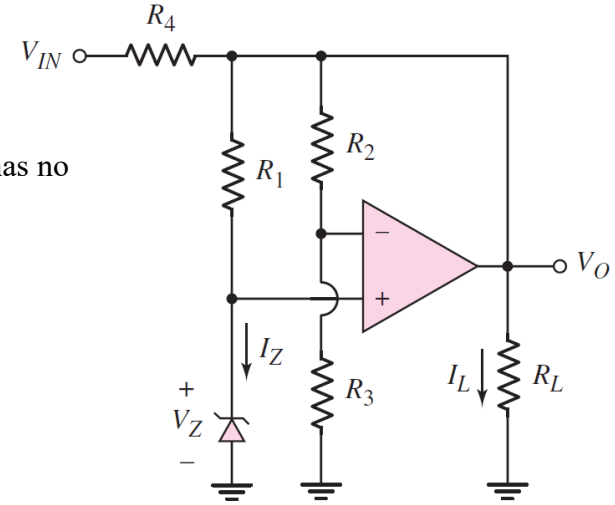
2. (25%) Consider the class-AB output stage. The diodes and transistors are matched with the same parameters $I_s = 6 \times 10^{-12}$A, and β = 40.
   (a) Determine the voltage V_{BEn} and R_1 such that the minimum current in the diodes is 25 mA when v_O = 24 V. (10%)
   (b) Following (a), what are the voltage across the diode D_1 and the voltage V_{EBp}? (10%)
   (c) Neglecting base current and assuming the diode cut-in voltage is 0.6V, determine the voltage across diode v_O = 0 V.



3. (20%) The circuit shown in the below is an active filter. Indicate what kind of filter it is and derive the 3dB corner frequency.



4. (15%) Consider the voltage reference circuit, using a Zener diode with a breakdown voltage of 5.6V. We design the circuit to produce an output voltage of 12.0 V with the input voltage of 15.0V and the Zener diode current $I_Z = 2mA$.
   (a) Find R_1. (5%)
   (b) Let the current of R_2 be $2mA$. Find R_2 and R_3. (5%)
   (c) If $R_L = 3K\Omega$, find R_4 such that the op-amp has no output current. (5%)



5. (20%) In the difference amplifier shown in the below,
$R_1 = R_3 = 10$ kΩ, $R_2 = 20$ kΩ, and $R_4 = 21$ kΩ.
Determine the CMRR(dB).