編號： 198

國立成功大學 106 學年度碩士班招生考試試題

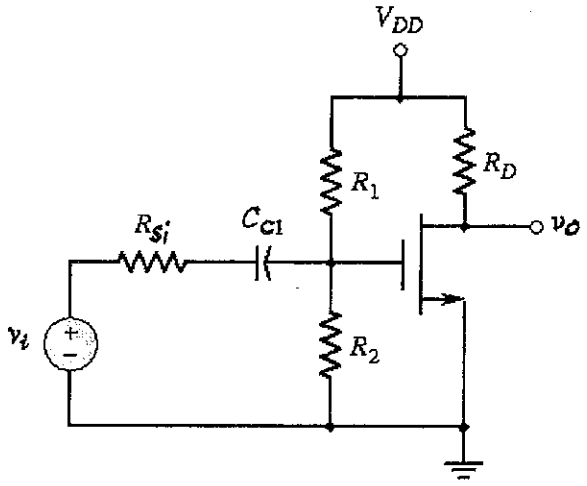
系　　所：電腦與通信工程研究所

考試科目：電子學

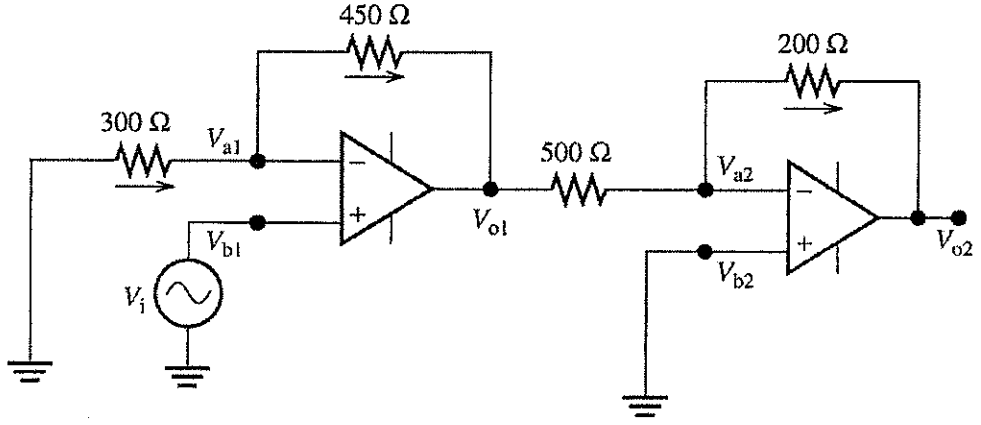
考試日期：0214，節次：1

※考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

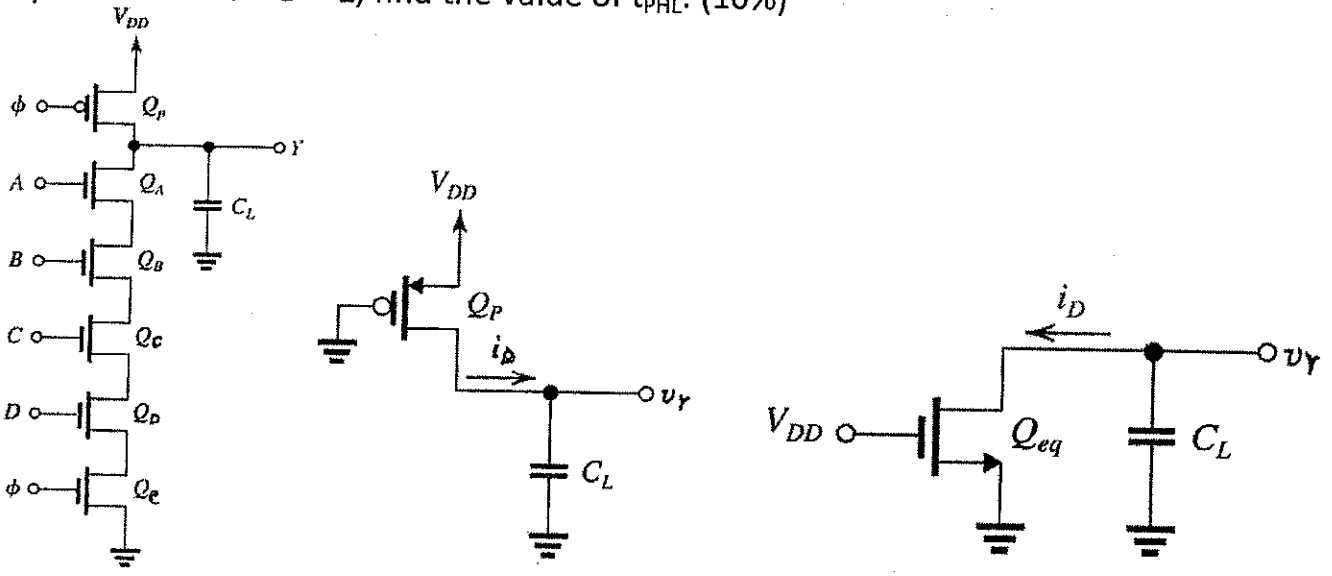
1. A Zener diode has an equivalent series resistance of 20 Ω. If the voltage across the Zener diode is 5.20 V at I_Z = 1 mA, determine the voltage across the diode at I_Z = 10 mA. (10%)
2. Consider an n-channel MOSFET with parameters V_{TN} = 1 V, $\mu_n C_{ox}$ = 40 μA/V^2, and W/L = 40. Assume the transistor is biased in saturation region, and the drain current is I_D = 1 mA. Calculate the transconductance (g_m) (10%).
3. For the circuit shown below, the parameters are: V_{DD} = 10 V, R_1 = 70.9 kΩ, R_2 = 29.1 kΩ and R_D = 5 kΩ. The transistor parameters are: V_{TN} = 1.5 V, K_n = 0.5mA/V^2, and λ = 0.01 V^{-1}. Assume R_{Si} = 4 kΩ. Determine the small-signal voltage gain (10%), input resistance (5%) and output resistance (5%) of the common-source amplifier.



4. Consider a bipolar transistor that has parameters f_T = 500 MHz at I_C = 1 mA, β_0 = 100, and C_μ = 0.3 pF.Calculate the bandwidth f_β (10%) and capacitance C_π (10%).
5. Given V_i = 20V. Determine the output voltage V_{O2}. (10%)



6. Consider the four input dynamic-logic NAND gate shown below. Assume the gate is fabricated in a 0.18 μm technology for which V_{DD} = 1.8 V, V_t = 0.5 V, and $\mu_n C_{ox} = 4\mu_p C_{ox}$ = 300 μA/V^2. To keep C_L small, NMOS devices with W/L = 0.27 μm/0.18 μm are used. The PMOS precharge transistor Q_P has W/L = 0.54 μm/ 0.18 μm. The total capacitance C_L is found to be 20 fF.
   i) Consider the precharge condition (figure (b)) with the gate of Q_P at 0 V, and assume that at t = 0, C_L is fully discharged. Calculate the rise time of the output stage, defined as the time for v_Y to rise from 10% to 90% of the final voltage V_{DD}. (10%)
   ii) For A = B = C = D = 1, find the value of t_{PHL}. (10%)



(a) (b) (c)

7. Use the following circuit to realize a second-order low pass function of the maximally flat type with a 3 dB frequency of 100 kHz. Let R = 1KΩ. Find the values of L and C. (10%)