編號： 198

國立成功大學 105 學年度碩士班招生考試試題

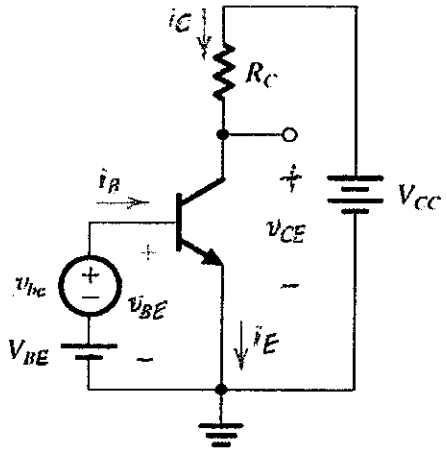
系　　所：電腦與通信工程研究所

考試科目：電子學

考試日期：0228，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. For the BJT as an amplifier with V_{CC} = 5 V, R_C = 3kΩ, and β = 100, V_{BE} is adjusted so that V_C = 2 V. A signal v_{be}= 5 sin(ωt) mV is applied. Find the instantaneous response $i_c(t)$ (5%), $v_c(t)$ (5%) and the voltage gain (5%).



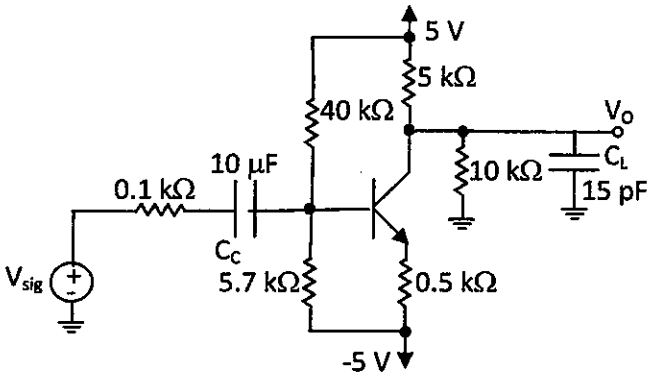
2. For an n-channel MOSFET, given the threshold voltage V_{tn} = 0.3 V, conductance parameter K_n = (1/2*W/L*$\mu_n C_{ox}$) = 12.5 mA/V^2: (a) At V_{GS} = 0.8 V, V_{DS} = 0.05 V, the transconductance ($g_m = \frac{\partial I_D}{\partial V_{GS}}$) = ? (A/V) (5%)(b) At V_{GS} = 0.8 V, V_{DS} = 1.5 V, the transconductance = ? (A/V) (5%).

3. For an nMOS transistor fabricated in a 0.25 μm CMOS process with μ_n = 400 cm^2/V·s, $\mu_n C_{ox}$ = 115 μA/V^2,V_{tn} = 0.5 V, λ_n = 0.06 V^{-1}, W/L = 1.5 and V_{DD} = 2.5 V:

(a) Let L = 0.25 μm and assume saturation velocity $v_{sat} = 10^7$ cm/s. Find V_{DSsat}. (5%)

(b) Continue (a), let $V_{GS} = V_{DS} = V_{DD}$, calculate the drain current (in velocity saturation). (10%)

4. For a CE amplifier with a coupling capacitor C_C and a load capacitor C_L. Given I_c = 1 mA and β = 100. You may neglect the effect of r_O and r_x. Find the bandwidth ($f_H - f_L$) (Hz). (10%) Hint: $r_\pi = \beta/g_m$.



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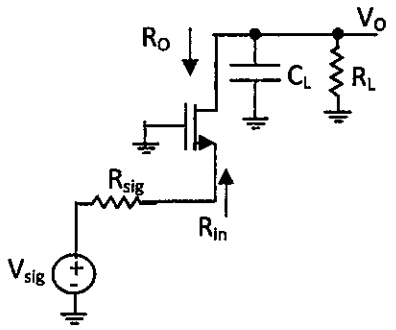
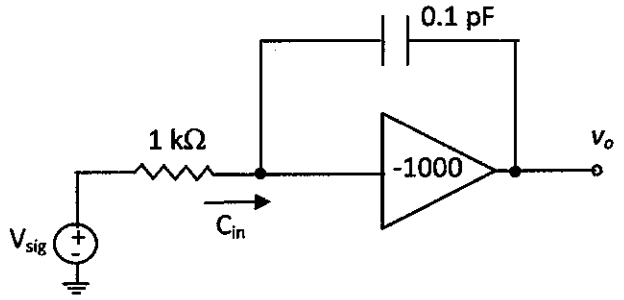
5. For a common gate amplifier having g_m = 1.25 mA/V, r_o = 20 kΩ, C_L = 15 fF, R_L = 20 kΩ, R_{sig} = 10 kΩ, C_{gs} = 20 fF, and C_{gd} = 5 fF, (a) find the mid-band voltage gain (10%) and (b) use the method of open-circuit time constantsto find the 3-dB frequency f_H (Hz) (10%). Hint: $R_{in} = (r_O + R_L)/(1+g_m r_O)$, $R_O = r_O + (1+g_m r_O)R_{sig}$.



6. The following figure shows an ideal voltage amplifier with a gain of -1000 V/V. (a) Use Miller's theorem to find the input capacitance (C_{in}) of the amplifier. (10%) (b) Find the 3-dB frequency f_H (Hz) of the transfer function (V_O/V_{sig}). (5%)



7. A two-stage CMOS op amp is found to have a capacitance between the output node and ground of 1 pF. If the op amp should have a unity gain bandwidth f_t of 100 MHz with a phase margin of 75°, what must g_{m6} be set to? (10%) Assume that a resistance R is connected in series with the frequency-compensation capacitor C_C and adjusted to place the transmission zero at infinity. What is the value of R? (5%)