編號： 127

國立成功大學 105 學年度碩士班招生考試試題

系　　所：工程科學系

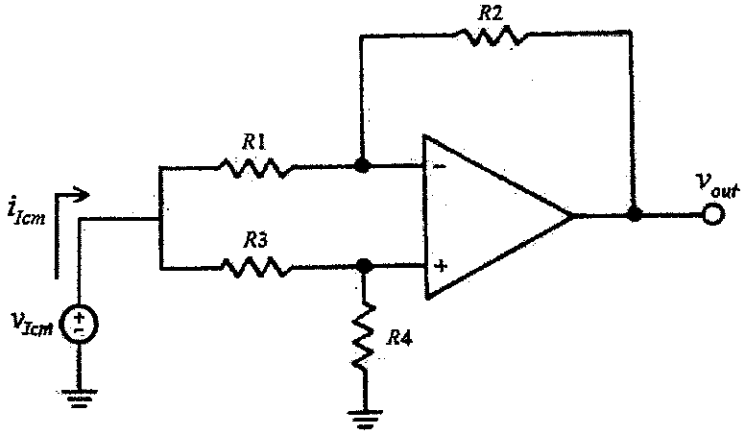
考試科目：電子電路

考試日期：0228，節次：1

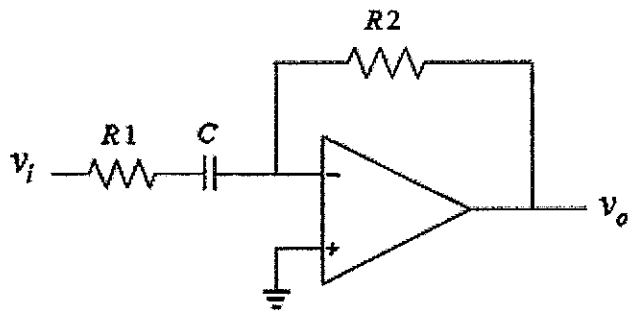
※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。***請依題號順序作答。***

1. A device is characterized by its current i_D (mA) and voltage v_D (V) as $i_D = K(1+v_D)^3$, where $K=1$ mA/V^3. (a) Find its small-signal equivalent model (10 pt.). (b) If the DC voltage $V_D = 2$ V, find the DC current I_D and the transconductance g_m. (10 pt.)

2. In the following circuit, (a) if $R1$=1 kΩ, $R2$=2 kΩ, $R3$=4 kΩ, and $R4$=2 kΩ, find v_{out} expressed by v_{Icm} (5 pt.); (b) if $R1$=1 kΩ, $R2$=2 kΩ, $R3$=4 kΩ, and $R4$=2 kΩ, find $R_{Icm} \equiv \frac{v_{Icm}}{i_{Icm}}$ (5 pt.); (c) if $R1$=$R3$=1 kΩ and $R2$=$R4$=2 kΩ, find v_{out} expressed by v_{Icm} (5 pt.); (d) if $R1$=$R3$=1 kΩ and $R2$=$R4$=2 kΩ, find $R_{Icm} \equiv \frac{v_{Icm}}{i_{Icm}}$ (5 pt.).



3. The following circuit performs the high-pass, single-time-constant function. Such a circuit is known as a first-order high-pass active filter. (a) Design the circuit to obtain a high-frequency input resistance of 100 kΩ , a high-frequency gain of 40 dB, and a 3-dB frequency of 100 kHz. (15 pt.) (b) At what frequency does the magnitude of the transfer function reduce to unity? (5 pt.)



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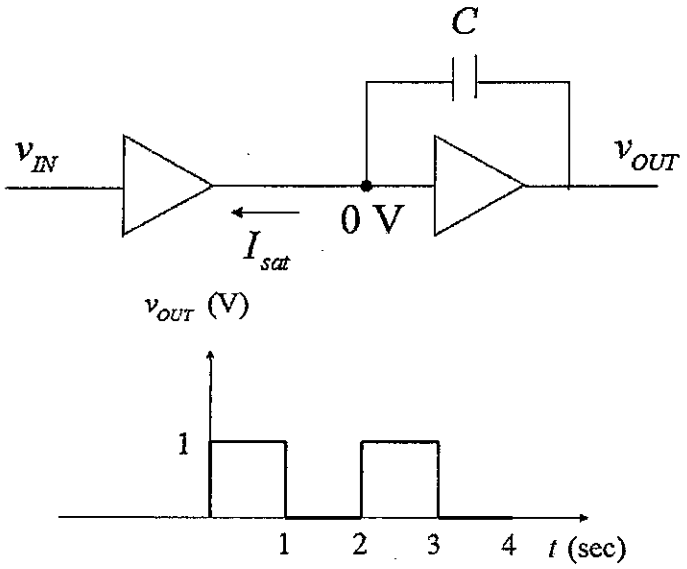
4. The figure shows a two-stage amp, the 1st stage saturates owing to the large input voltage, where $I_{sat} = 0.1\ \text{mA}$ and $C = 100\ \mu\text{F}$. (a) Find the slew rate. (5 pt.) (b) If the ideal output is a square wave shown below, plot the real output waveform which is distorted by the slew rate. (10 pt.)



5. For the circuit shown below, assume $V_t = 1.5\ \text{V}$, $V_A = \infty\ \text{V}$, and $k_n'\left(\frac{W}{L}\right) = 0.25\ \text{mA/V}^2$. Find (a) DC operating point. (5 pt.) (b) Its small-signal voltage gain. (5 pt.) (c) The amplitude of the largest allowable input signal and the minimum allowable v_{DS}, i.e., $v_{DS,\min}$. (5 pt.) (d) Please change the resistance of *RD* such that the DC drain voltage $V_D = \frac{V_{DD} + v_{DS,\min}}{2}$, where $v_{DS,\min}$ denotes the minimum allowable v_{DS} obtained in (c). (5 pt.) (e) Also, find the amplitude of the largest allowable input signal and the new minimum allowable v_{DS}, i.e., $v'_{DS,\min}$ in this case again. (5 pt.)