國立臺北科技大學九十六學年度碩士班招生考試

系所組別：1740 電腦與通訊研究所丁組

第二節 電子學 試題

注意事項：

1. 本試題共 10 題，配分共 100 分。每題 10 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Use only one operational amplifier to design a circuit with the following output $V_o(s)$, where $V_1(s)$ and $V_2(s)$ are the inputs.

$$V_o(s) = -\frac{1}{8s}V_1(s) + \frac{1}{4}(1+\frac{1}{8s})V_2(s)$$

2. The operational transconductance amplifier (OTA) is a voltage-input current-output active device with infinite input impedances and the output current $I_o = g_m(V_+ - V_-)$, where g_m is the transconductance of the OTA, V_+ and V_- are the voltages of positive and negative terminals of the OTA. If $g_{m1} = g_{m2} = g_{m3} = g_m$, and V_1, V_2, V_3, V_4 are the inputs and V_{o1}, V_{o2}, V_{o3} are the outputs, find the pole frequency ω_o and quality factor Q of the biquadratic filter shown in Fig.1.

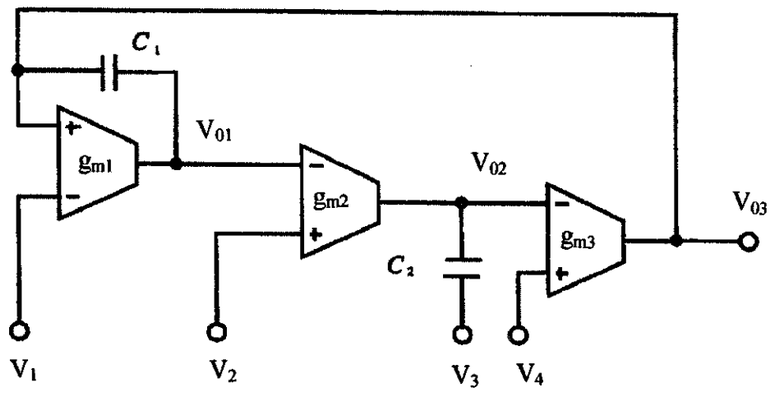

Fig.1

3. The second-generation current conveyor (CCII) is a new active device with the following relationships: $I_Y = 0$, $V_X = V_Y$, $I_Z = \pm I_X$, where plus and minus signs denote CCII+ and CCII- , respectively. The plus sign is taken to mean I_X and I_Z both flowing simultaneously toward or away from the CCII+, and the minus sign indicates I_X flowing into the CCII- and I_Z flowing out the CCII-, and vice versa. Find the condition of oscillation and the frequency of oscillation of the oscillator shown in Fig.2.

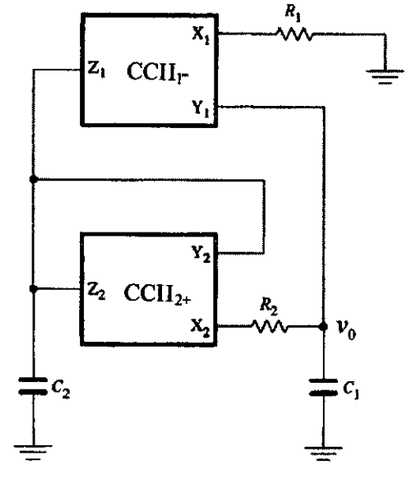

Fig.2

4. A CMOS double pair is shown in Fig.3, where both MOS transistors are in the saturation region. The transistor pair can be equivalent to a single transistor with an equivalent threshold voltage $V_{t\text{-}eq}$ and equivalent device parameter K_{eq} . We define the equivalent threshold voltage $V_{t\text{-}eq}$ as $V_{t\text{-}eq} = V_{tn} - V_{tp}$, where V_{tn} and V_{tp} are the threshold voltages of NMOS Q_n and PMOS Q_p , and $V_{tn} > 0$, $V_{tp} < 0$. If K_n and K_p are the device parameters of Q_n and Q_p , find the equivalent device parameter K_{eq} using K_n and K_p .

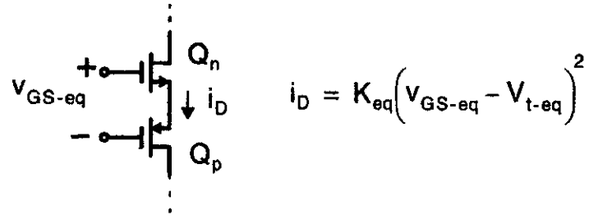

Fig.3

5. The fastest analog-to-digital converter (ADC) is called the simultaneous, parallel or flash ADC. Sketch the circuit of a 3-bit flash ADC.

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6. Fig.4 shows the basic two-stage CMOS operational amplifier. Explain the operating principle of the circuit including the function of every element clearly and what are the advantages and disadvantages of the two-stage CMOS operational amplifier ?

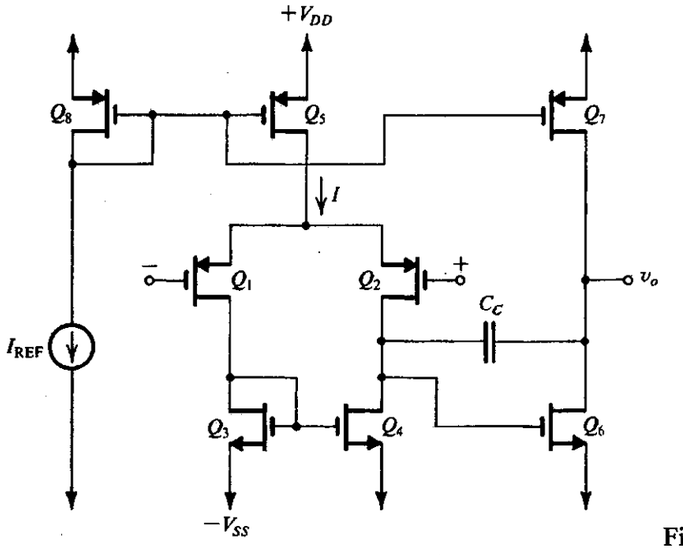

Fig.4

7. In the Fig.5, what type of feedback circuit is employed in the current amplifier ? Neglect the channel length modulation effect and the body effect and assume that the transconductances of all MOS transistors are g_m , find the current gain I_{out}/I_{in} .

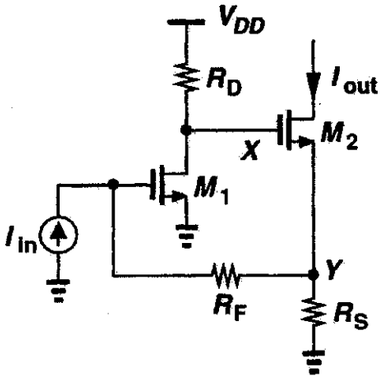

Fig.5

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8. Given six inputs A, B, C, D, E, F, design a Domino CMOS logic circuit to implement the logic function Y = AB+C+DEF .

9. Fig.6 shows the CMOS layout, sketch the corresponding CMOS circuit, where a, b, c are three inputs, and Out is the output.

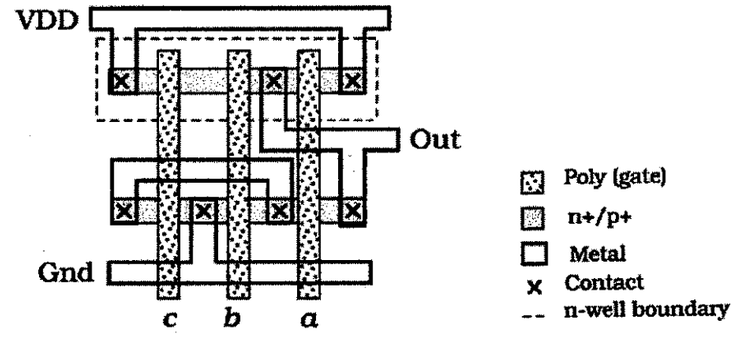

Fig.6

10. Sketch the cross-section diagram and the I_D-V_{GS} characteristic curve of a double-diffused vertical power MOS transistor (DMOS).