系所組別：醫學資訊研究所

考試科目：應用電子學 考試日期：0223，節次：3

※ 考生請注意：本試題不可使用計算機

註:請提供詳細推導過程，並帶入計算數字；不需求出開根號之數字。

1. (28%) Consider the following circuit in Fig. 1, with circuit parameters $V^+ = 5$ V, $V^- = -5$ V, $R_S = 4$ kΩ, $R_D = 2$ kΩ, $R_L = 4$ kΩ, and $R_G = 50$ kΩ. The transistor parameters are: $K_P = 1$ mA/V^2, $V_{TP} = -1$ V, and $\lambda = 0$. (a) Plot the equivalent circuit when v_i is 0 V (4%). Calculate I_{DQ}, V_{SGQ}, $V_{SD(SAT)}$ (6%); (b) Assuming the frequency of input signal is within an appropriate range, so the impedance of all external capacitors and the transistor capacitances can be neglected. Plot the small-signal equivalent circuit (4%). Find g_m (4%), small-signal gain $A_v = V_o/V_i$ (6%), and input resistance R_i (4%).

2. (30%) The transistor parameters for the circuit shown in Fig. 2 are: β=180, $V_{BE(ON)}$=0.7 V, Early voltage for Q_1 and Q_2 are $V_A = \infty$ and for Q_3 and Q_4 are $V_A = 100$V. (a) Determine R_1 and R_2 such that $I_1 = 0.5$ mA and I_Q=140 μA. (8%). (b) Plot the small-signal equivalent circuits when $v_1 = v_2$ (5%) and when $v_1 \neq v_2$ (5%). (c) Derivate the common-mode input resistance. (6%) (d). Derivate the common-mode voltage gain. (6%)

3. (20%) Design a DC power supply with output voltage of 12 V. Provide a complete block diagram of the circuit, describe function of each sub-circuit and your design consideration. (20%)

4. (22%)You will apply ideal operational amplifiers to design circuits. (a) What are the characteristics for an operational amplifier to be ideal?(5%) (b) Design and plot an instrumentation amplifier circuit and explain how to control the voltage gain. (10%) (c) Design and plot a two-pole low pass filter circuit. (7%)

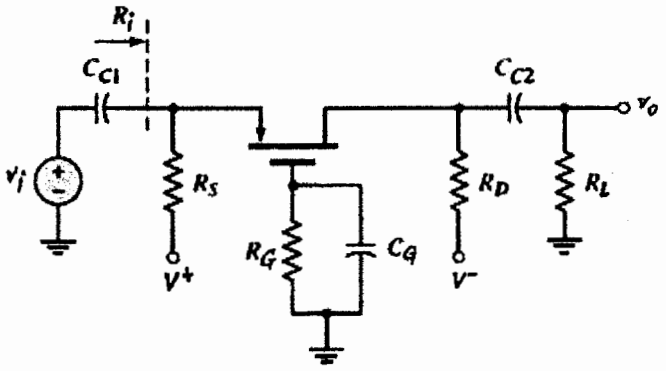

Fig. 1

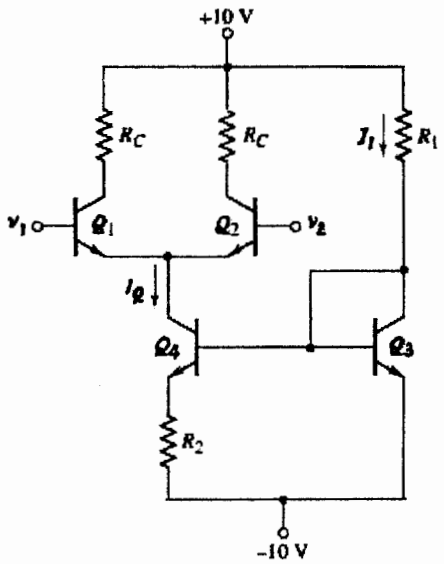

Fig. 2