所別：光電科學與工程學系碩士班 不分組(一般生)　科目：電子學　共 2 頁 第 1 頁
光電科學與工程學系碩士班 不分組(在職生)
本科考試可使用計算器，廠牌、功能不拘　＊請在試卷答案卷（卡）內作答

1. Figure 1 shows an op-amp circuit for 4-bit digital-to-analog converter (DAQ), which can convert a 4-bit digital word $a_3a_2a_1a_0$ to an analog output. The value of each bit is represented by a corresponding switch. That is, if a_0 is 1 then switch S_0 connects to the +5-V power supply, while if a_0 is 0 then switch S_0 connects to ground.

   (a) Find R_1 and R_2 so that $vo = -\frac{R_3}{8}\left(2^0 a_0 + 2^1 a_1 + 2^2 a_2 + 2^3 a_3\right)$. (10%)

   (b) Find R_3 so that v_o ranges from 0 to – 24 volts. That is, the digital words 0000 and 1111 are converted to 0 V and -24 V, respectively. (5%)

   (c) Based on this circuit, please design an op-amp circuit which can convert a 4-bit digital word to an analog output ranging from 0 to 12 V. Any reasonable scheme is allowed. (10%)

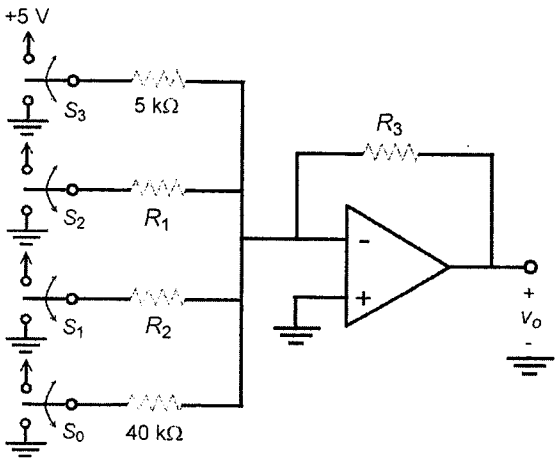

Fig. 1

2. For an active filter shown in Figure 2, please answer the following questions:
   (a) Determine the transfer function $\mathbf{H}(s) = \mathbf{V}o/\mathbf{V}s$, where $s = j\omega$. (5%)
   (b) Show that this active filter is a band-pass filter. (3%)
   (c) For R_1 = 1 kΩ and C_2 = 0.1 μF, find R_2 and C_1 so that the band-pass filter has a resonant frequency at 500 rad/s. (6%)
   (d) Draw the Bode plot for the magnitude of the band-pass filter in (c). (5%).
   (e) For the band-pass filter in (c), find the bandwidth B and quality factor Q. (6%)

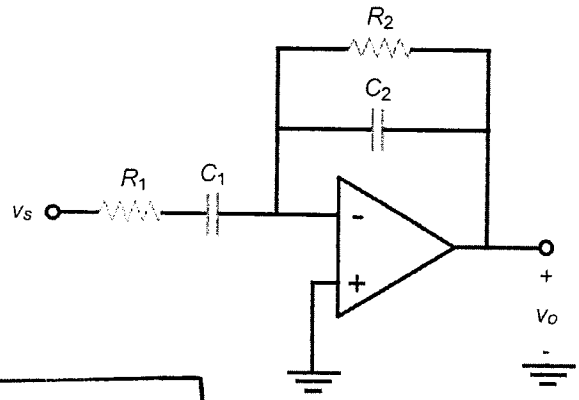

Fig. 2

注意：背面有試題

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3. The cut-in voltage for each diode in Fig. 3 is $V_\gamma = 0.5$ V.
   (a) Find V_1 and V_2 and each diode current for $R_1 = 2$ KΩ, $R_2 = 3$ KΩ, and $R_3 = 2$ KΩ. (5%)
   (b) Define the load line of diode D_3 in this circuit. (5%)

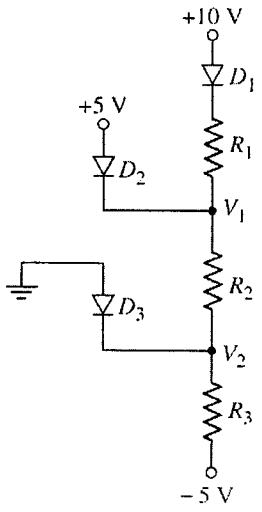

Fig. 3

4. For the circuit in Figure 4, the parameters are $V_{TN} = 1.5$ V and $Kn = 0.6$ mA/V^2 for transistors M_1 and M_2.
   (a) Determine that I_D, V_{GS1}, V_{DS1}, V_{GS2}, and V_{DS2} for transistors M_1 and M_2, respectively. (5%)
   (b) Define the load lines for transistor M_1. (5%)
   (c) Sketch the current-voltage characteristics of transistors M_1 and M_2. (10%)

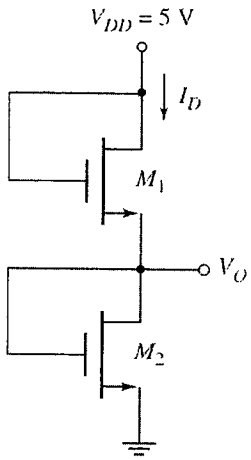

Fig. 4

5. A common-gate circuit shown in Figure 5. The transistor parameters are $V_{TN} = 0.5$ V, $Kn = 2$ mA/V^2, and $\lambda = 0$, $C_{gs} = 10$ pF, $C_{gd} = 2$ pF.
   (a) Determine the upper 3 dB frequency. (10%)
   (b) Determine the midband voltage gain. (10%)

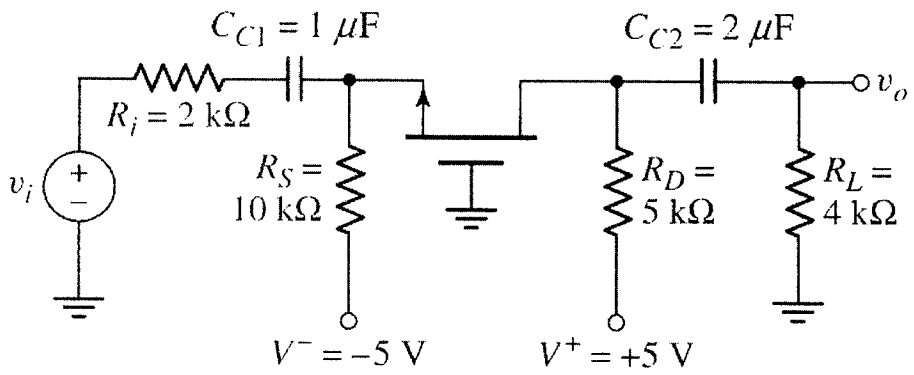

Fig. 5

注意：背面有試題