國立台灣科技大學九十六學年度碩士班招生試題

系所組別： 電機工程系碩士班乙二組、丙三組、乙二高職教師組

科　　目： 電子學

總分100分

1. Find the **overall voltage gain,** v_L / v_S**, current gain,** i_o / i_i**, power gain,** P_L / P_I, and discuss the function of each stage as shown in Fig. P1. (15 %)

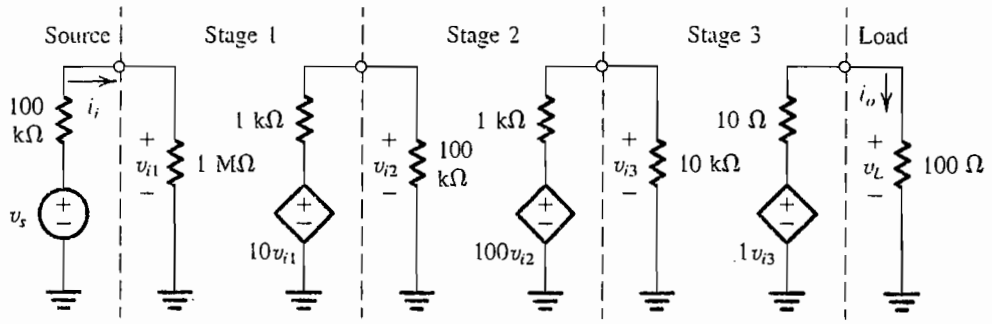

Fig. P1

2. (a) Assume the diodes to be ideal, find the value of **I** and **V** in the circuit of Fig. P2A. **(5 %)**

(b) Using exponential mode of the diode and iterative analysis to determine the current I_D and the diode voltage V_D for the circuit in Fig. P2B with V_{DD}=5V and R=1 kΩ. Assume that the diode has a current of 1 mA at the voltage of 0.7V and its voltage drop changes by 0.1V for every decade change in current. **(10 %)**

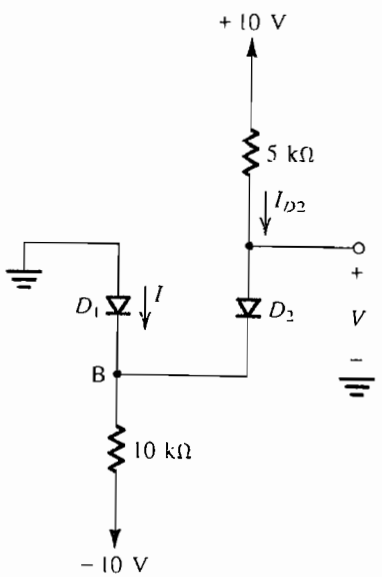

Fig. P2A

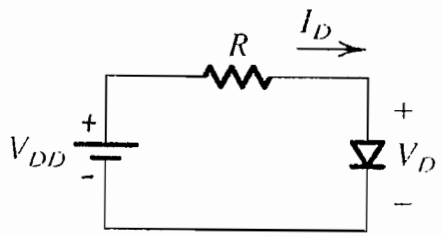

Fig. P2B

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3. (a) It is required to find the **midband gain** and **upper 3-dB frequency** f_H of the circuit as shown in Fig. P3 for the following case: **(10 %)**

$V_{CC} = V_{EE} = 10$ V, $I = 1$ mA, $R_B = 100\ k\Omega$, $R_C = 8\ k\Omega$, $R_{sig} = 5\ k\Omega$, $R_L = 5\ k\Omega$, $\beta_0 = 100$, V_A=100V, V_T=25 mV, $C_\mu = 1$ pF, $f_T = 800\ MHz$, and $r_x = 50\ \Omega$.

(b) Select appropriate values for $\mathbf{C_{C1}}$, $\mathbf{C_{C2}}$, **and** $\mathbf{C_E}$ to have lower 3-dB frequency $f_L = 120\ Hz$. Let the values of C_{C1}, C_{C2}, and C_E are selected to contribute 0.1, 0.1, and 0.8 of the value of ω_L. **(10 %)**

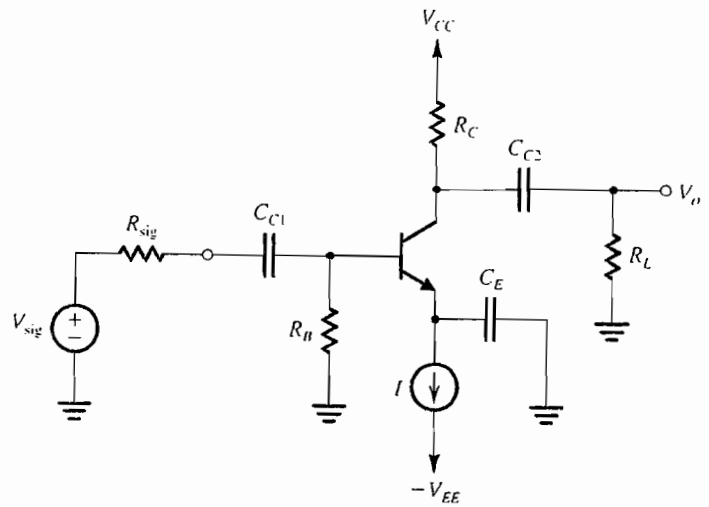

Fig. P3

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4. For the circuit shown in Fig. P4, assume that both OPAs are ideal and V_{REF} =1V.
   (a) Explain why the currents flow through both R_1 are equal even $\delta \neq 0$. (5%)
   (b) Denote the output of OA_1 as v_{O1}. Derive the relationship between v_{O1} and δ. (8%)
   (c) Derive the relationship between v_O and δ. (8%)

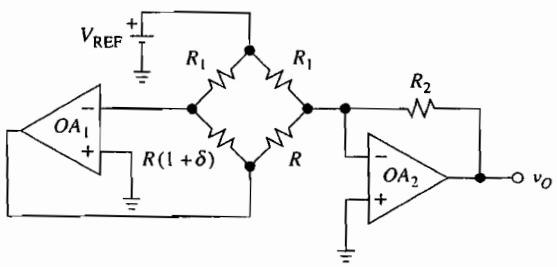

Fig. P4

5. The OPA in the circuit of Fig. P5 has an open-loop transfer function

$$A(s) = \frac{10^5}{1 + s/20}.$$

   (a) Derive the transfer function of the loop gain $A(s)\beta(s)$. (5%)
   (b) By asymptotic approach, sketch the magnitude of the loop gain in dB versus frequency on a logarithmic scale. [Hint: $\log 20 = 1.301$] (6%)
   (c) Find the frequency at which $|A(j\omega)\beta(j\omega)|$=1. (6%)

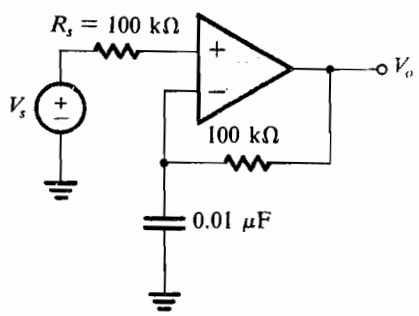

Fig. P5

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6. The circuit of Fig. P6 is a band-pass filter. Assume that the OPA is ideal and the values of the components are as follow: $R_1 = R_2 = 10\text{k}\Omega$ and $C_1 = C_2 = 0.1\mu F$.
   (a) Derive the transfer function of this band-pass filter. (6%)
   (b) Calculate the center frequency and Q factor of this filter. (6%)

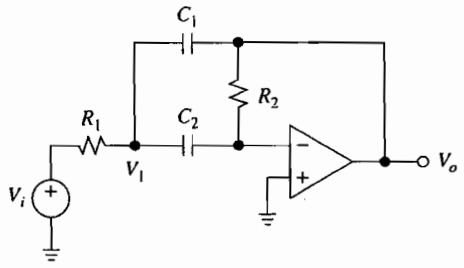

Fig. P6