

國立中央大學104學年度碩士班考試入學試題

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

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本科考試可使用計算器，廠牌、功能不拘

*請在答案卷(卡)內作答

- The transistor in the circuit in Fig. 1 has parameters are $V_{TN} = 0.5 \text{ V}$ and $K_n = 0.5 \text{ mA/V}^2$, $V_{DD} = 3 \text{ V}$, $R_D = 1 \text{ k}\Omega$, $R_{Si} = 1 \text{ k}\Omega$, $v_i = (-1 + 0.1 \sin \omega t) \text{ V}$, $C_{gd} = 5 \text{ pF}$, $C_{gs} = 50 \text{ pF}$, $r_o \rightarrow \infty$.
 - Determine the small-signal voltage gain $A_v(s)$. (10%)
 - Determine the 3dB frequency for the small-signal voltage gain. (5%)
 - Sketch Bode plots of magnitude (5%) and phase (5%) for the circuit.
 - Plot output voltage versus time for the circuit as the signal frequency is set at 1 MHz. (5%)
- The op-amp in Fig. 2 is ideal. The resistors are set as $R = R_1 = R_2 = 1 \text{ k}\Omega$. The diodes D_1 and D_2 have piecewise linear parameters of turn on (cut-in) voltage $V_r = 0$ and forward diode resistance $r_f = 0$. If input voltage $v_i = 6 (\sin \omega t) \text{ V}$ is applied.
 - Plot v_o versus v_i for the circuit. (5%)
 - Plot v_o versus time for the circuit. (5%)
- For the circuit shown in Fig. 3, derive the expressions for the voltage transfer function $T(s) = V_o(s)/V_i(s)$ (5%), determine the cutoff frequency f_{3dB} (5%).
- For the circuit shown in Fig. 4, determine
 - the Bode magnitude plot of v_o to v_i ; (5%)
 - the Bode phase plot of v_o to v_i ; (5%)
 - the possible applications. (5%)
- Consider the circuit with multiple output transistors shown in Fig. 5. Assume $V_{BE1} = 0.7 \text{ V}$. Evaluate the values of R_{E2} (5%) and R_{E3} (5%) such that $I_{O2} = 20 \mu\text{A}$ and $I_{O3} = 80 \mu\text{A}$.
- For the circuit shown in Fig. 6, draw the small-signal equivalent circuit (5%) and determine the voltage gain (5%), the current gain (5%), the input resistance (5%), and the output resistance (5%) according to the equivalent circuit.

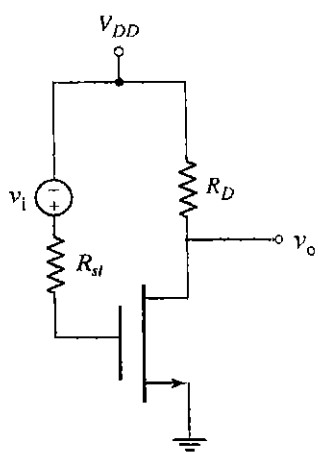


Fig. 1

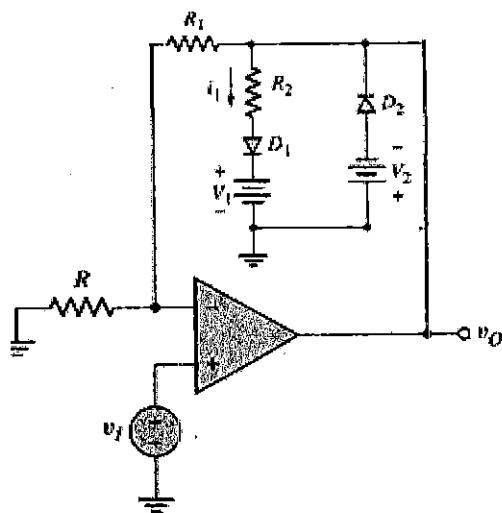


Fig. 2

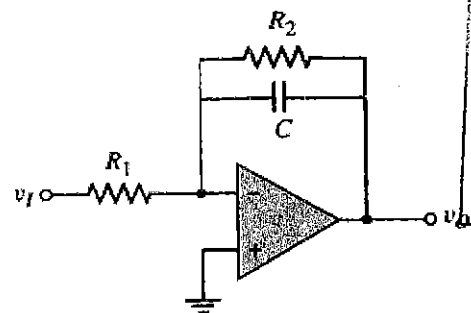


Fig. 3

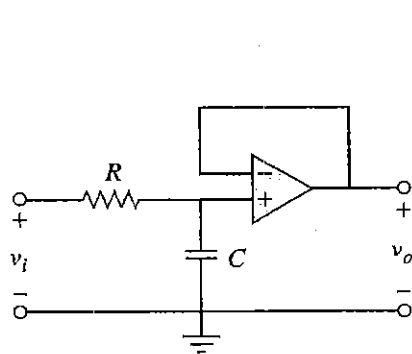


Fig. 4

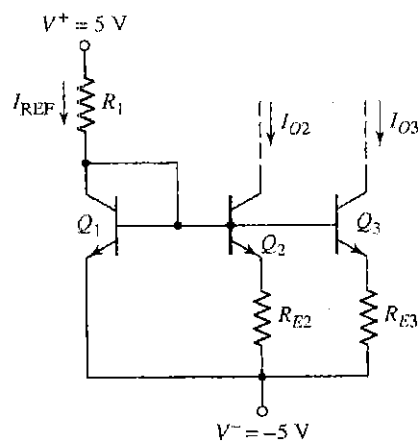


Fig. 5

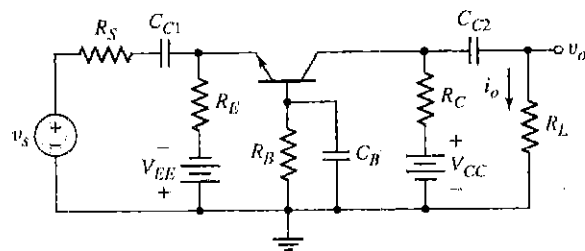


Fig. 6

參考用