1. (a) Figure 1 shows a noninverting amplifier utilizing a single internally-compensated op amp. The gain of the op amp may be expressed as $A(s) = A_o/(1+\frac{s}{\omega_b})$, where A_o and ω_b are the dc gain and 3-dB frequency, respectively. Derive the 3-dB frequency of the noninverting amplifier. (14 分)

(b) Redesign the amplifier by cascading three identical noninverting amplifiers. Each noninverting amplifier is the same as Fig. 1. Derive the 3-dB frequency of the overall amplifier. (6 分)

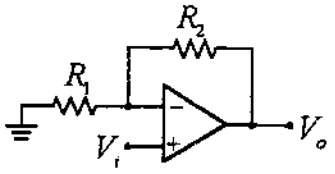

Fig. 1

2. For the circuit shown in Fig. 2, both diodes are identical, conducting 10 mA at 0.7 V and 100 mA at 0.8 V. In the forward region the $i_D - v_D$ relationship of the diode is approximated by $i_D = I_S e^{v_D/nV_T}$, where I_S the saturation current and $V_T = 25\,\text{mV}$.

(a) Determine n and I_S. (6 分)

(b) Find the value of R, for which $V_O = 0.15\,\text{V}$. (14 分)

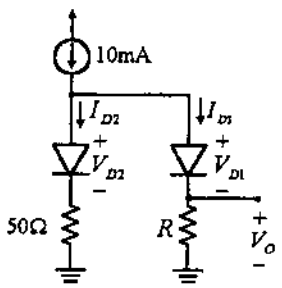

Fig. 2

3. A circuit is shown in Fig. 3. The BJT has $\beta = 200$ and neglect the effect of r_o.

(a) Find the dc emitter current, g_m and r_π of the BJT. (5 分)

(b) Replace the BJT with its hybrid-π model.and determine the input resistance R_i. (5 分)

(c) Determine the voltage gain v_o/v_s. (10 分)

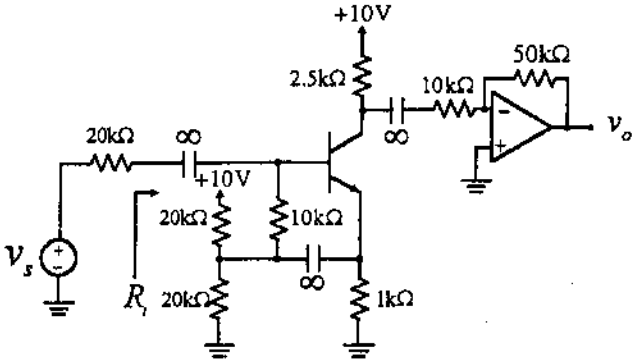

Fig. 3

4. Determine a Butterworth filter transfer function $T(s)$ that meets the specifications shown in Fig. 4. (20 分)

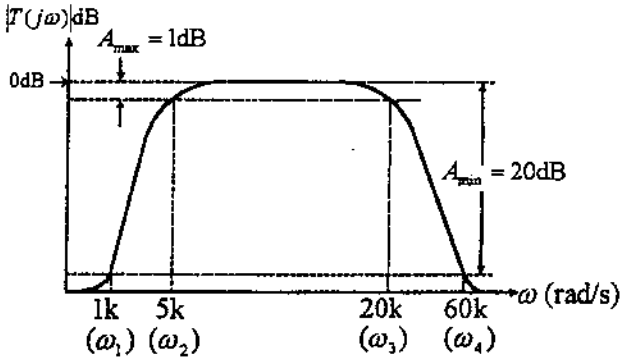

Fig. 4

5. Determine the transfer function $V_o(s)/V_i(s)$ in Figs. 5(a) and 5(b). (20 分)

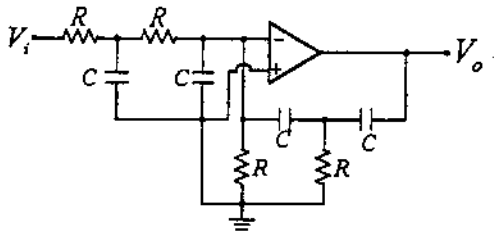

Fig. 5(a)

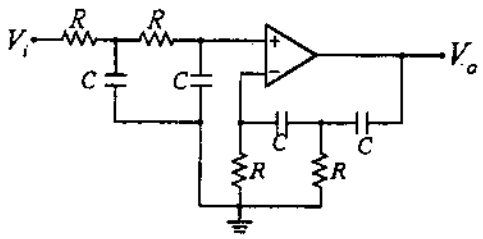

Fig. 5(b)