

- A bipolar transistor circuit is shown in Fig. 1. The common-emitter output characteristics of the transistor is shown in Fig. 2. If the amplitude of the signal source V_s is 26.5 mV and the small-signal input resistance R_i is 725 ohm. Please estimate :

 - The value of I_{BQ} , I_{CQ} , and V_{CEQ} of the operation point.
 - The signal current and voltage gain A_i and A_v .
 - The total power supplied by the DC bias and signal source. (20%)
- The characteristics for transistor Q_1 and Q_2 , used in the circuit shown in Fig. 3, are Fig. 4 and Fig. 5, respectively. If the threshold voltages of Q_1 and Q_2 are $V_t=2V$ and $V_t=-2V$, respectively. Determine V_{DS1} and V_{DS2} . (10%)
- A TTL NAND gate with a totem-pole output is shown in Fig. 6. The transfer characteristics (V_o-V_i) of this gate is illustrated in Fig. 7. Please calculate the values of V_{OH} , V_{OB} , V_{OL} , V_{IL} , V_{IB} , and V_{IH} . (20%)
- A operational amplifier with current bias circuit is shown in Fig. 8.

 - Calculate its slew rate.
 - What is the maximum frequency of an output sinusoid of 5V peak-to-peak value before slew-rate distortion exists? (20%)
- (i) Show a switched-capacitor equivalent of the circuit in Fig. 9. (10%)
 (ii) In (i), R is replaced by $C=1PF$. What is the clock rate? (10%)
- For the circuit in Fig. 10-1, assuming the I-V of Fig. 10-2 for the diodes, plot

 - transfer characteristic of v_o-v_i .
 - output waveform v_o with input v_i shown in Fig. 10-3. (20%)

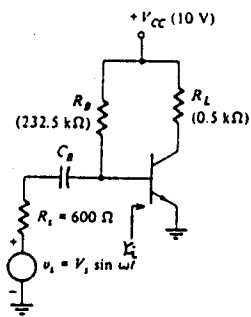


Fig. 1

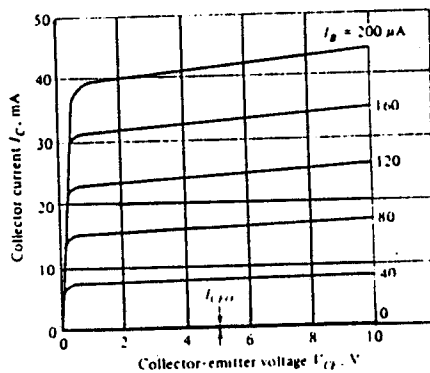


Fig. 2

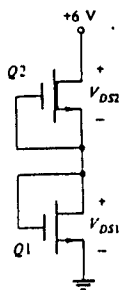


Fig. 3

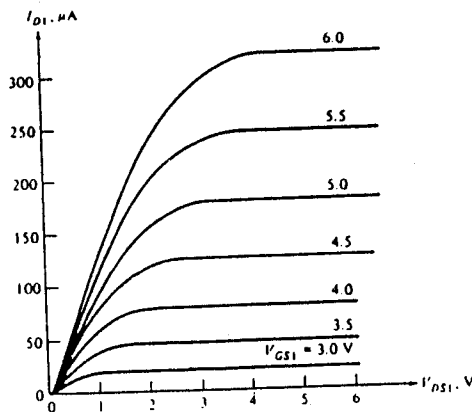


Fig. 4

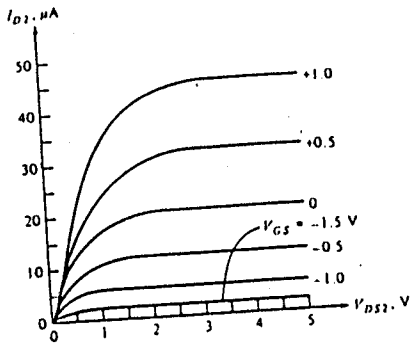


Fig. 5

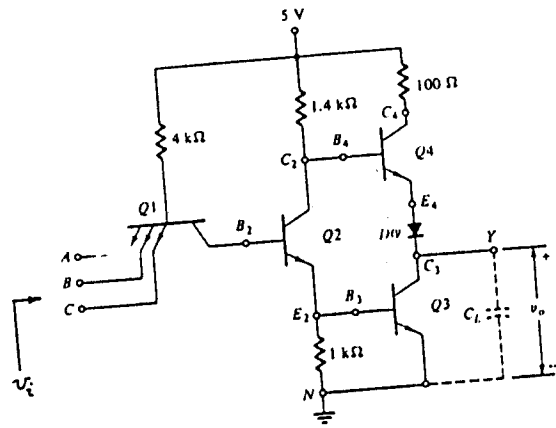


Fig. 6

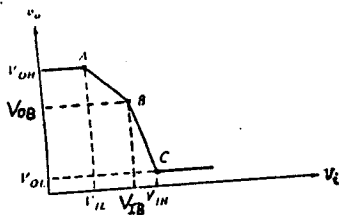


Fig. 7

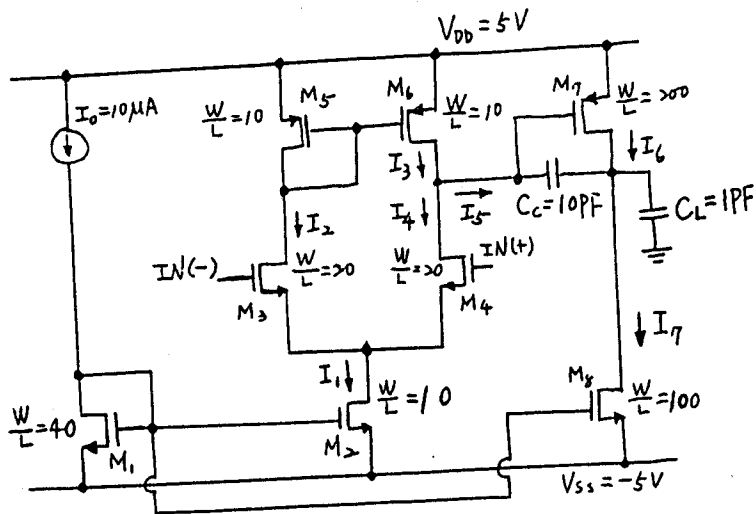


Fig. 8

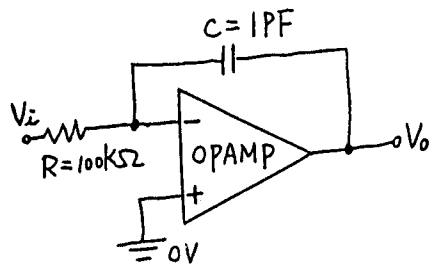


Fig. 9

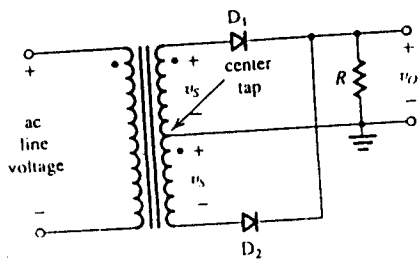


Fig. 10-1

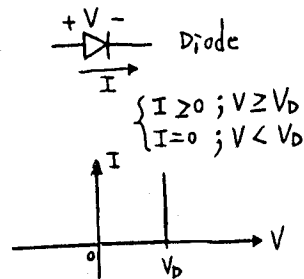


Fig. 10-2

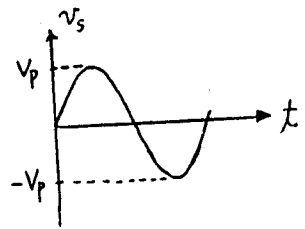


Fig. 10-3