1. (a) Explain base-width modulation (the Early effect) and its influence.
   (b) What do the acronymns EPROM and E²PROM mean?
   (c) Define f_β and f_T. What is the relationship between f_β and f_T?
   (d) What is the significance of the threshold voltage V_T in enhancement-mode and depletion-mode MOSFET's. (16%)

2. A bipolar transistor is biased at $I_C = 0.5\ mA$ and has $\beta_0 = 150$.
   (a) Determine g_m and r_π at room temperature.
   (b) The input resistance $h_{ie} = 7.6\ k\Omega$. Find r_b.
   (c) A load resistance $R_C = 2\ k\Omega$ is used and the transistor is driven from a 300-Ω source and operated in common-emitter configuration. Estimate the voltage gain. (12%)

3. (a) For the circuit shown in Fig. 1, verify that $Y = \overline{ABC}$.
   (b) If $\beta = 25$, what is the fan-out?
   (c) What is the average power dissipated by the gate assuming $Y = V(1)$ 50 percent of the time? (12%)

4. The circuit in Fig. 2 is designed with $V_{CC} = 15\ V$, $R = 30\ k\Omega$, and $R_E = 1\ k\Omega$. Q_1 and Q_2 are identical transistors, and the related parameters are $\beta_F = 200$, $\beta_0 = 200$, $V_A = \infty$, and $r_b = 0$.
   (a) Determine I_{C1}.
   (b) What is the percentage change in I_{C1} if V_{CC} increases by 0.3V? (12%)

5. The transistors in the circuit shown in Fig. 3 are identical and have $r_\pi = 4\ k\Omega$ and $\beta_0 = 200$.
   (a) Determine the value of f_L for each stage, assuming $C_{B1} = C_{B2} = 1\ \mu F$ and $C_{E1} = C_{E2} = 100\ \mu F$.
   (b) What is the lower half-power frequency of the cascade? (12%)

6. (a) For the circuit shown in Fig. 4, determine T, A_{OL}, and A_F.
   (b) Evaluate R_{OF}. The MOSFETs have $g_m = 1\ mU$, $r_d = 20\ k\Omega$. (12%)

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7. For the oscillator shown in Fig.5, find the frequency of oscillation and the minimum value of R. (12%)

8. For the logic diagram of the synchronous counter shown in Fig.6 with initial state $Q_0 = Q_1 = Q_2 = 0$.
(a) Write the truth table of Q_0, Q_1, and Q_2 after each pulse.
(b) This system is a N:1 counter, determine the value of N. (12%)

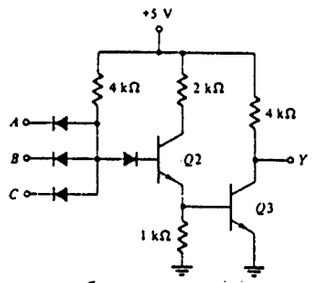

Fig. 1.

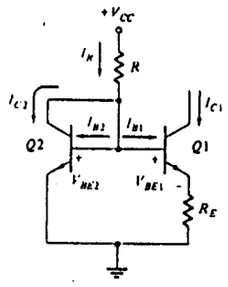

Fig. 2.

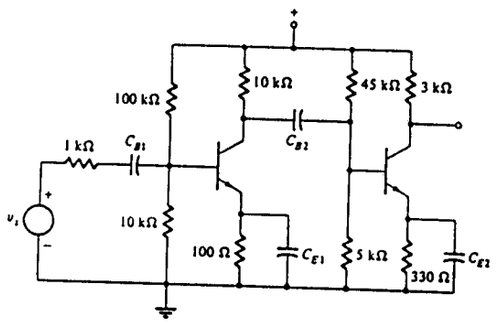

Fig. 3.

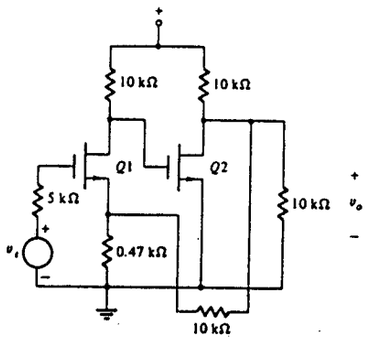

Fig. 4.

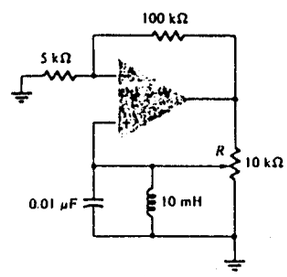

Fig. 5.

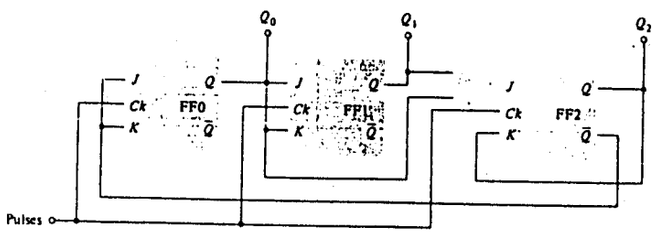

Fig. 6.