Department of Electrical Engineering
Indian Institute of Technology, Kanpur

EE 210 **Assignment #13** **Assigned: 13/4/21**

1. Consider an NMOS common-source stage, as shown in Fig.1, with I_D = 0.5 mA. Using the ZVTC method, estimate the upper cutoff frequency of the circuit. Data: W = 100 μm, L = 2 μm, k'_N = 60 μA/V^2, $C_{sb} = C_{db}$ = 20 fF, C'_{ox} = 0.7 fF/μm^2, and C_{gd} = 14 fF. Also, calculate the rise time for pulse response. Neglect the body effect and the CLM effect.

2. Show that, neglecting R_S, Fig.2(a) is the 2-port representation of a CE(D) circuit, shown in Fig.2(b) with $R_\pi = r_\pi(1 + g_m R_E)$, and $G_m = g_m/(1 + g_m R_E)$. Hence, using the ZVTC technique, evaluate its upper cutoff frequency. Data: R_S = 10 kΩ, R_L = 5 kΩ, R_E = 300 Ω, β = 200, f_T = 600 MHz (at I_C = 1 mA), C_μ = 0.2 pF, and I_C = 1 mA. Also, calculate the rise time for pulse response.

3. The ac schematics of a common-source-common gate (cascode) stage is shown in Fig.3. Using the ZVTC technique, estimate its upper cutoff frequency. Use the data given in Prob.1, and assume that χ_2 = 0.2. Also, calculate the rise time for pulse response.

4. A wideband monolithic current amplifier is shown in Fig.4. The dc collector bias current of Q_1 is equal to 1 mA, and the emitter area of Q_2 is four times that of Q_1. Calculate the ac small-signal midband current gain i_0/i_i, and use the ZVTC method to estimate the upper cutoff frequency. Also, calculate the rise time for pulse response. Data: for both Q_1 and Q_2: β = 200, and τ_F = 0.2 nsec; for Q_1: C_μ = 0.2 pF, and C_{je} = 1 pF; and for Q_2: C_μ = 0.8 pF, and C_{je} = 4 pF.

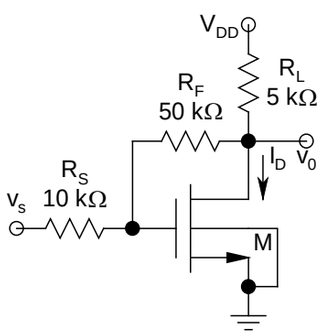
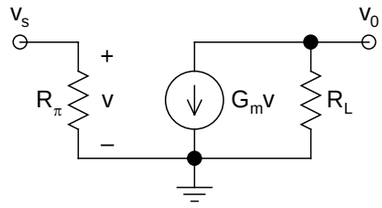
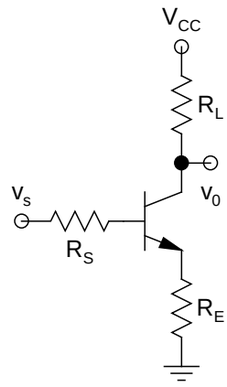


Fig.1



(a)



(b)

Fig.2

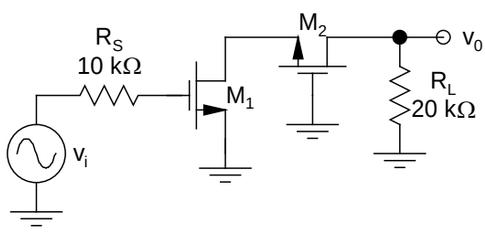


Fig.3

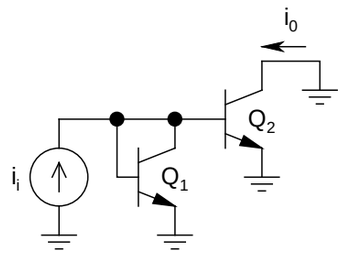


Fig.4