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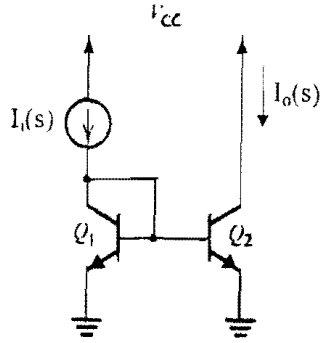
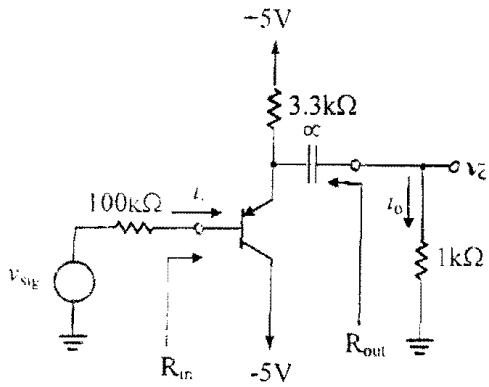
1. For the current mirror in the right figure derive an expression for the current transfer function $I_o(s)/I_i(s)$ taking into account the BJT internal capacitances and neglecting r_x and r_o. Assume the BJTs to be identical, Observe that a signal ground appears at the collector of Q_2. If the mirror is biased at 1mA and the BJTs at this operating point are characterized by f_t=400MHz, C_μ=2pF, and $\beta_0=\infty$, find

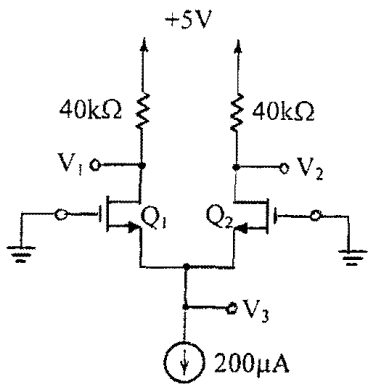


(a)the frequencies of the pole (f_p)of the transfer function. f_p=_____ (7%)
(b)the frequencies of the zero (f_z)of the transfer function. f_z=_____ (6%)

2. For the emitter follower in the right figure, the signal source is directly coupled to the transistor base. If the dc component of v_{sig} is zero, (a) find the dc emitter current (5%). Assume β=100. Neglecting r_o, (b) find R_{in} (5%), (c) the voltage gain v_o/v_{sig} (5%), (d) the current gain i_o/i_i (5%), and (e) the output resistance R_{out}. (5%)



3. In the below figure, transistors Q_1 and Q_2 have V_t=1V, and the process transconductance parameter k_n'=100μA/V^2, Assuming λ=0, find V_1, V_2, and V_3 for $(W/L)_1=1.5(W/L)_2$. (12%)



(背面仍有題目,請繼續作答)

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4.(a)Use the superposition principle to find the output voltage of the circuit shown in Fig.1.(b) If in the circuit of Fig.1 the 1-kΩ resistor is disconnected from ground and connected to a third signal source v_3, use superposition to determine v_0 in term of v_1, v_2 and v_3.(10%)

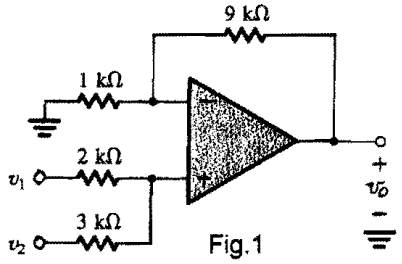
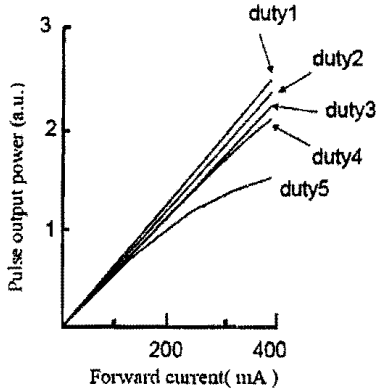


Fig.1

5. Consider a Si n-channel MOSFET with channel width W=15 μm, length L=2 μm , gate oxide thickness t_{ox}=0.5 μm, dielectric constant ε_{ox}=3.9. Assume that the drain current in the saturation region for V_{DS}=0.10V is I_D=3.5mA at V_{GS}=1.5V and I_D=75 mA V_{GS}=2.5V. (a)Please find the inversion carrier mobility (μ_n) in channel and the threshold voltage(V_T). (b)please comment the determined μ_n compared with the bulk mobility.(10%)
6. As shown in Figure 2, if the five light output power-current (L-I) curves correspond to a GaAs LED operated at different pulsed injection currents, i.e., different duty cycles, which is defined in the inset of Figure 2. Please identify which of the following item(s) is(are) true.(A)duty1> duty 2(B) duty 3> duty 4(C) duty 2> duty 5(D) duty 3> duty 2(E) duty 5> duty 4(2%)



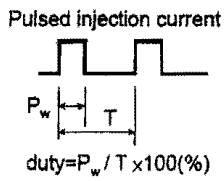


Figure 2

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7. Under thermal equilibrium, which of the following approache(s) can create a built-in electric field in a semiconductor?(A)p-n junction(B) spatial variation of doping concentration(C)n-type GaAs(D)intrinsic Si.(2%)
8. The zener diode in the circuit of Figure 3 is specified to have V_Z=6.8V at I_Z=5 mA,r_z=20 Ω and I_{zk}=0.2 mA. The power supply voltage V^+=10V.
   (A) V_o = 6.83 V with no load (B) I_L=13.6 mA when R_L=0.5KΩ(C) V_o = 5 V when R_L=0.5KΩ (D) I_Z = 6.35 mA with no load (6%)

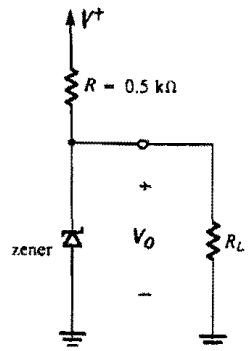

Figure 3

9. The threshold voltage will increase for a n-channel MOS FET when (A)increase the reverse bias of substrate increase (B) decrease the doping concentration of substrate (C)increase the thickness of gate oxide (D) increase the gate length. (3%)
10. Which of the following statement(s) is(are) true(A)The BJT transconductance increases exponentially with respect to V_{BE}.(B)The MOS FET's transconductance increases linearly with respect to V_{GS}.(C)A PMOS FET has four terminals(D)Compared with MOS FET, BJT device has higher input impedance. (3%)

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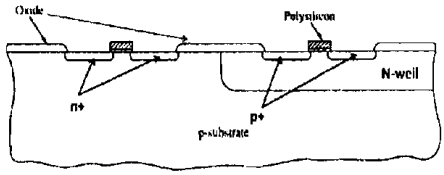
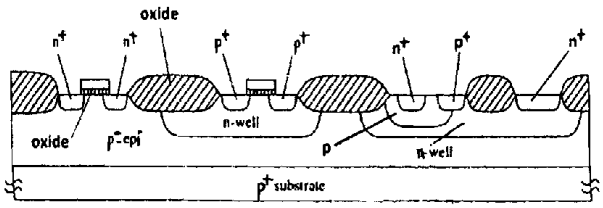
11. Please identify the following schematic device.

(a)_____(2%)



(b)_____(2%)



12. Determine the output voltage V_o in the following circuit when (a) $V_1=V_2=5V$ (5%)(b) V_1= 5V, V_2=0. Assume that the D_1 is identical to D_2 with $r_D=30\ \Omega$, $V_{D0}=0.6V$(5%)