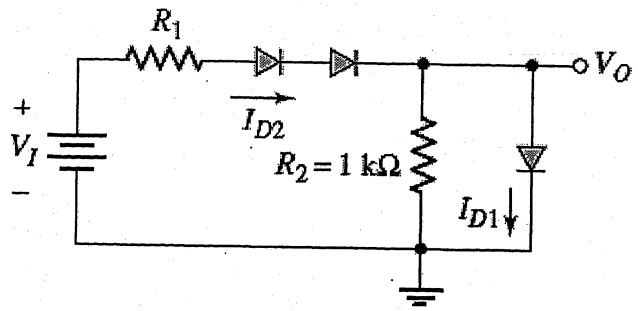
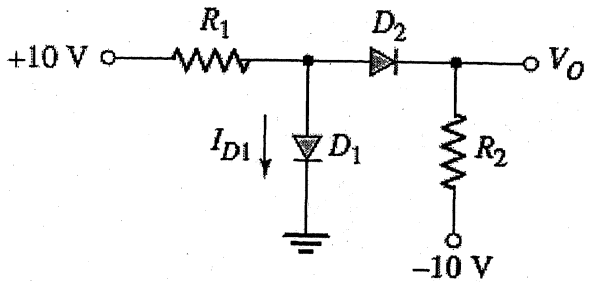
Indian Institute of Technology Kharagpur

Basic Electronics (EC21101) End semester 2008-09 (Spring)
Time 3 hours Full marks 100

1. Assume each diode in the circuit shown in Figure below has a cut-in voltage of $V\gamma = 0.65V$. (a) The input voltage is $V_I = 5V$. Determine the value of R_1 required such that I_{D1} is one-half the value of I_{D2}. What are the values of I_{D1} and I_{D2}? (b) If $V_I = 8V$ and $R_1 = 2k\Omega$, determine I_{D1} and I_{D2}. 10

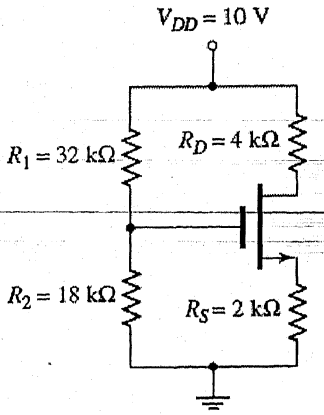


2. Let $V\gamma = 0.7$ V for each diode in the circuit in Figure below (a) Find I_{D1} and V_O for $R_1 = 5k\Omega$ and $R_2 = 10$ kΩ. (b) Repeat part (a) for $R_1 = 10$ kΩ and $R_2 = 5k\Omega$. 5+5=10

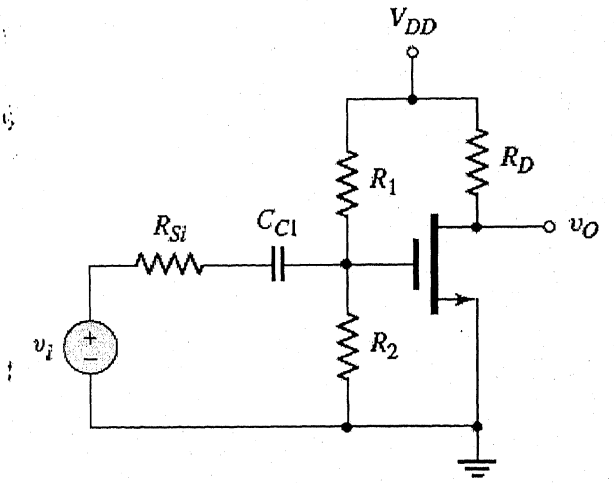


3. Consider an n-channel enhancement-mode MOSFET with the following parameters: $V_{TN} = 0.75$ V, $W = 40$ μm, $L = 4$ μm, $\mu_n = 650$ cm^2/V-s, $t_{ox} = 450$ Å, and $\varepsilon_{ox} = (3.9)(8.85 \times 10^{-14})$ F/cm. Determine the current when $V_{GS} = 2V_{TN}$, for the transistor biased in the saturation region. 10

4. In the circuit in Figure below, the transistor parameters are $V_{TN} = 0.8$ V and $K_n = 0.5$ mA/V^2. Calculate V_{GS}, I_D, and V_{DS}. 10



5. For the circuit shown in Figure below, the parameters are: V_{DD} = 10 V, R_1 = 70 kΩ, R2 = 29.1 kΩ, and RD = 5 kΩ. The transistor parameters are: V_{TN} = 1.5 V, Kn = 0. mA/V^2, and λ = 0.01V^{-1}. Assume R_{Si} = 4 kΩ. Determine the small-signal voltage gai and input and output resistances of a common-source amplifier. 1

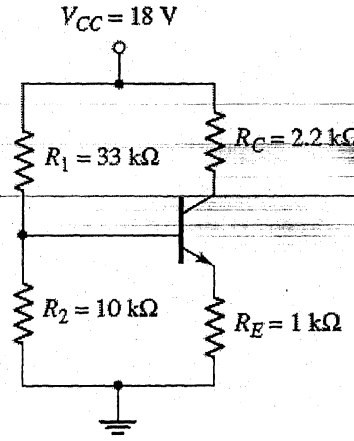


6. An NMOS transistor has parameters V_{TN} = 0.8 V, k'_n = 80 μA/V^2, and λ = 0. (a Determine the width-to-length ratio (W/L) such that gm = 0.5 mA/V at I_D = 0.5 mA whe biased in the saturation region. (b) Calculate the required value of V_{GS}. 10

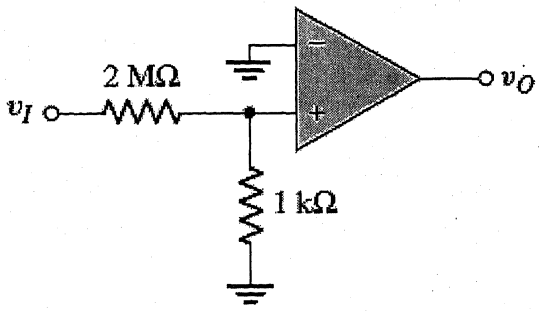
7. a) Calculate the collector and emitter currents, given the base current and curren gain. Assume a common-emitter current gain of β = 150 and a base current of i_B = 15 μA Also assume that the transistor is biased in the forward-active mode.

b) Draw the current components in BJT. And draw the common-emitter mod circuit configuration of BJT 3+5+2=10

8. For the transistor in the circuit shown in Figure below, β = 50. Determine I_{CQ} an V_{CEQ}. Sketch the load line and plot the Q-point. 10



9. The circuit in Figure below has an op-amp that is ideal except that it has a finite gain A_{od} . (a) If the gain A_{od} is 5×10^3 and the input voltage is $V_I = 3.0V$, what is the output voltage V_O? (b) If the input voltage is $V_I = 3.0V$ and the output voltage is $V_O = 3.0V$, what is the op-amp gain A_{od} ? 10



10. Consider the ideal inverting summing amplifier in Figure below. Let $R_1 = 50$ k Ω, $R_2 = 20$ k Ω, $R_3 = 100$ k Ω, and RF = 100 k Ω. (a) Determine V_O if $V_{I1} = 0.5V$, $V_{I2} = 0.75V$, and $V_{I3} = 2.5V$. (b) Determine V_{I3} if $V_{I1} = 1.0V$, $V_{I2} = 0.8V$, and $V_O = -2V$. 10