Analog Circuits (EE3002/EE5310) : Problem Set 3 shanthi@ee.iitm.ac.in

Problem 1



Figure 1: Circuit for problem 1.

In Fig. 1(a), determine the signs on the opamp for negative feedback operation. Determine the gate potential of the transistor for Vref=3 V and Vdd=5 V. Repeat for Vref=3 V and Vdd=3.5 V.

In Fig. 1(b), determine the signs on the opamp for negative feedback operation. Determine the gate potential of the transistor for Vref=3 V and Vdd=5 V. Repeat for Vref=0.5 V and Vdd=5 V.

In Fig. 1(c), determine the signs on the opamp for negative feedback operation. Determine the source potential of the transistor for Vref=3 V and Vdd=5 V. Repeat for Vref=1.8 V and Vdd=5 V.

For all the problems that follow, use $\mu_n C_{ox}(W/L) = 1 \text{ mA/V}^2$ and $V_T = 0.7 \text{ V}$. All capacitors are infinite.

Problem 2

In Fig. 2, determine the incremental gain vo/vi. Determine the largest input amplitude that can be used while still seeing a distortion-free output sinusoid.



Figure 2: Circuit for problem 2.



Figure 3: Circuit for problem 3.

Problem 3

In Fig. 3, determine the incremental gain vo/vi. Determine the largest input amplitude that can be used while still seeing a distortion-free output sinusoid. Compare the answers you get here with those from the previous problem.

Problem 4



Figure 4: Circuit for problem 4.

In Fig. 4, determine Rx so that the following conditions are satisfied.

- All transistors are in saturation.
- The distortion-free output swing is maximized.

Problem 5



Figure 5: Circuit for problem 5.

In Fig. 5, determine the incremental gain vo/vi. Determine the largest input amplitude that can be used while still seeing a distortion-free output sinusoid.

Problem 6



Figure 6: Circuit for problem 6.

In Fig. 6, determine the incremental gain vo/vi. Determine the largest input amplitude that can be used while still seeing a distortion-free output sinusoid. What is the output impedance of the amplifier (looking from the 12 K load)?

Problem 7



Figure 7: Circuit for problem 7.

In Fig. 7, determine the incremental gain vo/vi. Determine the largest input amplitude that can be used while still seeing a distortion-free output sinusoid. What is the output impedance of the amplifier (looking from the 12 K load)?

Problem 8

In Fig. 8, determine the incremental gain vo/vi for Rs=0. Determine the largest input amplitude that can be used while still seeing a distortion-free output sinusoid. What is the output impedance of the amplifier (looking from the 12 K load)?

Repeat the above with Rs=10 K. What do you notice? Why?



Figure 8: Circuit for problem 8.

Problem 9



Figure 9: Circuit for problem 9.

In Fig. 9, determine the incremental gain vo/vi. Determine the largest input amplitude that can be used while still seeing a distortion-free output sinusoid. What is the output impedance of the amplifier (looking from the 12 K load)?

Problem 10



Figure 10: Circuit for problem 10.

In Fig. 9, determine the incremental gain vo/vi. Determine the largest input amplitude that can be used while still seeing a

distortion-free output sinusoid. What is the output impedance of the amplifier (looking from the 12 K load)?

Problem 11



Figure 11: Circuit for problem 11.

In Fig. 11, determine the incremental gain vo/vi. Determine the largest input amplitude that can be used while still seeing a distortion-free output sinusoid.