

SANTA CLARA UNIVERSITY	ELEN 115 – Spring 2023	S. Krishnan
Homework #9-Part 1		

1. The MOS circuit in Figure 1 has a transistor M_1 with parameters

$V_T = 1.2\text{ V}$, $W = 25\mu\text{m}$, $L = 5\mu\text{m}$, $\lambda = 0$, and $k_n' = 40\mu\text{A/V}^2$

The input to the MOS circuit is $v_{IN}(t)$ and the output is $v_{OUT}(t)$.

Clearly show all the steps of your work.

- (a) Draw a rough voltage transfer curve showing v_{OUT} vs. v_{IN} for the circuit. [40]
 - (i) Label all points and axes on the graph.
 - (ii) Indicate the regions of operation of M_1 for the various portions of the graph.
 - (iii) Indicate the critical points on the graph and find v_{OUT} values for when M_1 changes region of operation and when $v_{IN} = 0\text{V}$ and $v_{IN} = V_{DD}$.
- (b) The MOS circuit is used as an amplifier and various inputs are given to the amplifier. Will it function properly providing an undistorted output? [30]

Explain why or why not for each case.

 - (i) $v_{IN}(t) = 1 + \cos 2\pi 10^3 t$
 - (ii) $v_{IN}(t) = 1 + 0.25 \cos 2\pi 10^3 t$
 - (iii) $v_{IN}(t) = 1 + 0.1 \cos 2\pi 10^3 t$
 - (iv) $v_{IN}(t) = 2 + \cos 2\pi 10^3 t$
 - (v) $v_{IN}(t) = 2 + 0.25 \cos 2\pi 10^3 t$
 - (vi) $v_{IN}(t) = 2 + 0.1 \cos 2\pi 10^3 t$
- (c) For any ONE of the inputs that provide an undistorted output in part (b) [50]
 - (i) Mark the operating point on the VTC.
 - (ii) What is V_{OV} at the operating point.
 - (iii) Find the transconductance of M_1 at the operating point.
 - (iv) Find the gain of the amplifier at the operating point.
 - (v) For the input you chose draw $v_{IN}(t)$ and the corresponding $v_{OUT}(t)$.

