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| Assignment-3 | EE204 - Analog Circuits | 28th Jan 2018 |
| Submission Deadline-17.00 5th Feb, 2018. | Submission Protocol: Drop hardcopy in the EE office | Comment: None |

1. A nMOS transistor has the following parameters: $V_{Tn}$ = +1 V, $k_n'$ = 1 mA/$V^2$, λ = 0.01 $V^{-1}$, $V_{DD}$ = +10 V, $V_{SS}$ = 0 V.
   I. Find out the DC biasing condition ($V_{GG,n}$ and $R_D$) such that $I_{DS}$ = 4.5 mA and the transistor is in the saturation region assuming a) the effect of λ is negligible and b) taking into account the effect of λ.
   II. Find out the CS gain of the above amplifier when output is taken from the drain terminal for both the above cases.
   III. Find out the required value for $V_{DD}$ such that the DC biasing condition is not changed with $R_D = r_0$ without neglecting the effect of λ.
   IV. $R_D$ is now replaced with a p-MOS in saturation having the following device parameters: $V_{Tp}$ = -1 V, $k_p'$ = 1/3 mA/$V^2$, λ = 0.01 $V^{-1}$, without changing the DC biasing condition for the nMOS. The resistance offered by the p-MOS is $r_0$ as in III. Find out all the biasing biasing voltages ($V_{GG,n}$, $V_{GG,P}$, $V_{DD}$, and $V_{SS}$ = 0) such that the DC biasing condition remains as in I a) neglecting the effect of λ and b) including the effect of λ.
   V. Find out the CS gain of of the amplifier in IV taking into account the effect of λ.
   VI. Redesign the circuit in IV with non-zero $V_{SS}$ such that the DC voltage at the drain node of nMOS is zero. Consider both the cases when a) λ is negligible and b) λ is not negligible.
   VII. Redesign the circuit in IV with non-zero $V_{SS}$ and $R_S$ = 1 kΩ such that the DC voltage at the drain node of nMOS is zero. Consider both the cases when a) λ is negligible and b) λ is not negligible.
   VIII. Find out the CS gain of of the amplifier in VII taking into account the effect of λ.
   IX. Find out the CS gain of the amplifier in VII at 1 kHz, 1 MHz and 1 GHz when $R_S$ is connected with a source bypass capacitor of 100 nF taking into account the effect of λ.