Université d'Ottawa
Faculté de génie
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uOttawa
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Canada's university

University of Ottawa
Faculty of Engineering
School of Electrical Engineering
and Computer Science

80 minute quiz, OPEN Book. Please write your student number on all sheets, including rough work.

Part A- Multiple choice Questions ANSWER ANY 10 Questions (see separate sheet 2) - worth 0.6%
See separate sheet – answer on the Question sheet.

Part B- Answer 2 Questions – show all formulas and rough work -- worth 1.4%

QB1.
For an NMOS differential pair with a common-mode voltage v_{CM} applied, as shown in Fig.1.
let $V_{DD} = V_{SS} = 3$ V, k'$(W/L) = 3$ mA/V^2, $V_{tn} = 0.7$ V, $I = 0.2$ mA, $R_D = 5$ kohm, and neglect channel-length modulation.
(a) Find V_{OV} and V_{GS} for each transistor.
(b) For $v_{CM} = 0$, find v_S, i_{D1}, i_{D2}, v_{D1}, and v_{D2}.
(c) Repeat (b) for $v_{CM} = +1$ V.
(d) Repeat (b) for $v_{CM} = -1$ V.
(e) What is the highest value of v_{CM} for which Q_1 and Q_2 remain in saturation?
(f) If current source I requires a minimum voltage of 0.3 V to operate properly, what is the lowest value allowed for v_S and hence for v_{CM}?

QB2.
For the differential amplifier of Fig. 2, let $I = 1$ mA, $V_{CC} = V_{EE} = 5$ V, $V_{CM} = -2$ V, $R_C = 3$ kΩ, and β = 100. Assume that the BJTs have $v_{BE} = 0.7$ V at $i_C = 0.5$ mA. Find the voltage at the emitters and at the outputs and estimate the Input resistance R_i and common mode gain A_{CM}.

Fig 1.

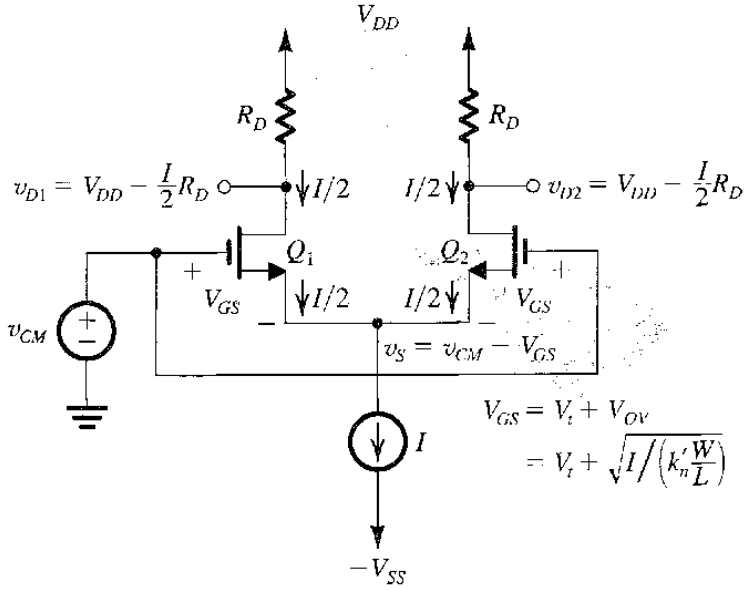

Fig 2