Carleton University: Department of Electronics
ELEC 3509 Midterm Exam

October 26, 2012
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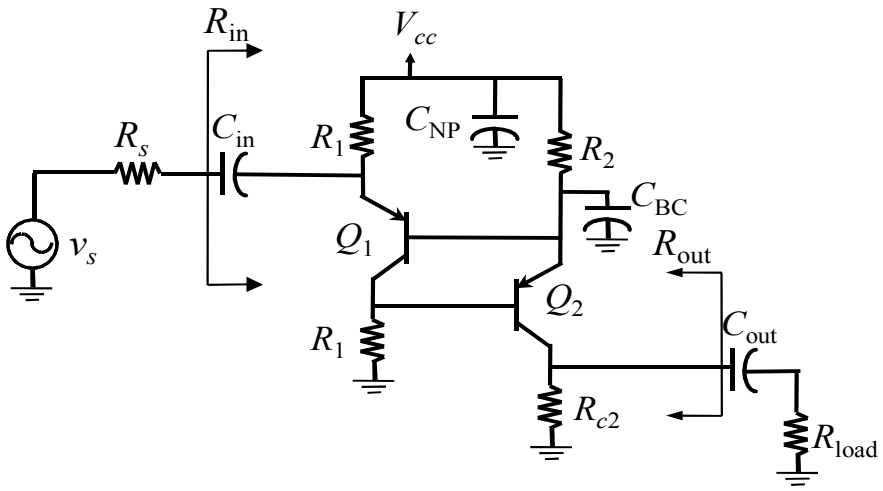
Duration: 1 hour
Total 25 Marks

Instructions:

- This is a closed book exam.
- Attempt all questions.
- Unless otherwise stated, use the simplified hybrid-π or T-model for all analysis (i.e. $r_\mu=r_o=\infty$ for both Q_1 and Q_2).
- Show all analysis and assumptions that you make.

1) Draw the small-signal equivalent circuit. (3 marks).
2) Find the mid-band gain A_v. (4 marks)
3) Find the mid-band R_{in}. (2 marks)
4) Find the mid band R_{out} (include r_{o2} and $r_{\mu 2}$). (4 marks)
5) Find the ω_L's for C_{in}, C_{NP}, C_{BC}, and C_{out}. (4 marks)
6) Find the ω_H's for the circuit. (4 marks)
7) Assume that V_{cc} = 15V, V_{CEsat} = 0.7V, and β=big. Set the values of all resistors necessary so that the collector current in Q_1 is 1mA and the collector current in Q_2 is 2mA. After this is done maximize the output swing. (4 marks)



$r_\pi = \frac{\beta}{g_m}$, $r_\pi = (\beta+1)r_e$, $\alpha = \frac{\beta}{\beta+1}$, $g_m = \frac{I_C}{V_T}$, $V_T = 25mV$ @ 20°C. $\omega_L \approx \omega_{L1} + \omega_{L2} + \omega_{L3} + \ldots$ and

$\frac{1}{\omega_H} \approx \frac{1}{\omega_{H1}} + \frac{1}{\omega_{H2}} + \frac{1}{\omega_{H3}} + \ldots$ Miller's Theorem: $Y_1 = Y\left(1 - \frac{v_2}{v_1}\right)$, $Y_2 = Y\left(1 - \frac{v_1}{v_2}\right)$ $I_c = I_s e^{\frac{V_{BE}}{V_T}}$