Course		Number	Section
Electronics II		ELEC 312	W
Examination	Date	Time	# of pages
Final Examination	April 27, 2005	3 hours	3

Instructor(s)

Dr. R. Raut

Materials allowed: [X] No [ ] Yes (Please specify)

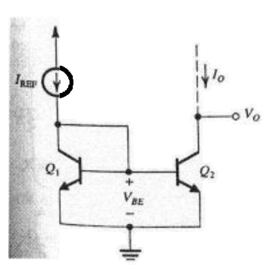
Calculators allowed: [ ] No [X] Yes

Students are allowed to use silent, non-programmable electronic calculators without text display.

Special Instructions:

Show all steps clearly in neat and legible handwriting (preferably in ink).
Students are required to return question paper together with exam booklet(s).

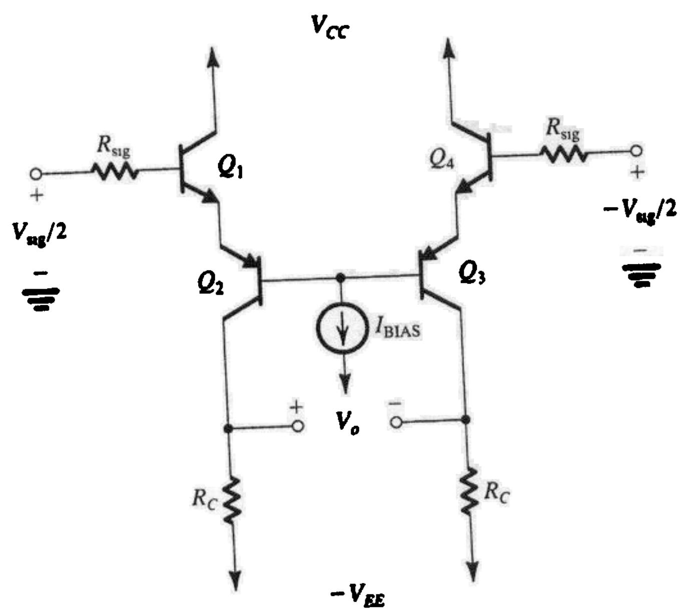
Q.1: Consider the basic BJT current mirror shown below. The transistor Q_2 has m-times the area of Q_1.



(a) What will be the current transfer ratio obtained?

(b) If the minimum β is specified to be 80, what is the largest current transfer ratio possible while keeping the error due to finite β limited to 5%?

Q.2: For the circuit shown below, let I_C for each transistor be 100 μA. The BJTs have β=200, f_T=600 MHz, and C_μ=0.2 pF. Further R_{sig} =R_C = 50 kΩ.



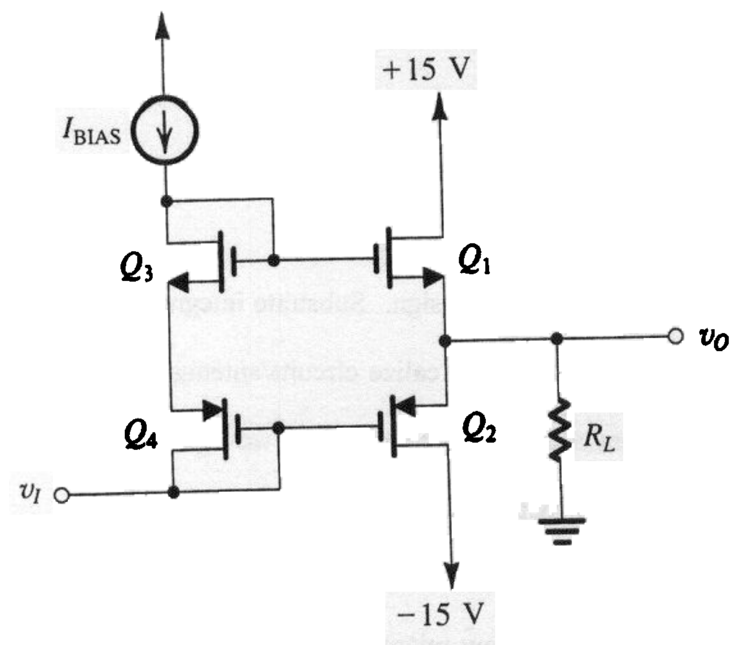
Find the low frequency gain, the high frequency poles and an estimate for f_H. You can neglect r_o and r_x for the transistors.

Q.3: A series-series feedback amplifier employs a transconductance amplifier having G_m=100 mA/V, input resistance of 10 kΩ, and an output resistance of 100 kΩ. The feedback network has β=0.1 V/mA, an input resistance (with port 1-open-circuited) of 100 Ω, and an input resistance (with port 2 open-circuited) of 10 kΩ. The amplifier operates with a signal source having a resistance of 10 kΩ and with a load resistance of 10 kΩ. Find A_f and R_{in} for the system.

Q.4: In a MOS amplifier, you are given the following: R_S=100 ohms, C_{gs}=0.1 pF, C_{gd}=20 fF, g_m =50 μ mho, I_{DC}=50 μA, V_A=20 V, and R_L= 5 k ohms. The MOS amplifier is configured to operate as CS amplifier. Find the dominant high-frequency pole of the amplifier using nodal analysis.

Q.5: A dc amplifier has an open-loop gain of 1000 and two poles, a dominant pole at 1 kHz and a high frequency pole whole location can be controlled. It is required to connect this amplifier in a negative-feedback loop that provides a dc closed-loop gain of 100 and a maximally flat response. Find the required value of β and the frequency at which the second pole can be placed.

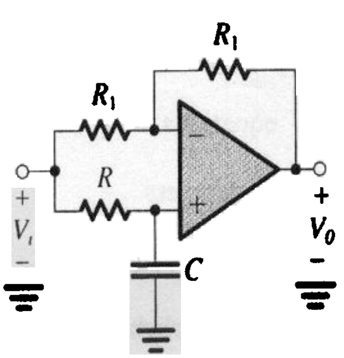
Q.6: The figure below shows a MOSFET class AB output stage. All transistors have $|V_t|$=1 V and $k_1=k_2=nk_3=nk_4$, where $k=\mu C_{ox}(W/L)$ is the MOSFET transconductance parameter. Aklso k_3=2mA/V^2.



For I_{BIAS} = 100 μA and R_L=1 kΩ, find the value of n that results in a small-signal gain of 0.99 for output voltages around zero. Find the corresponding value of I_Q.

<u>Bonus Question (6 marks)</u>

For the network shown below find an expression for T(s), the voltage transfer function. In this network R can be adjusted to obtain various phase shifts.



If the signal frequency is 10^4 rad/sec., and if C=10 nF, what values of R will produce a phase shift of -60° and -150° respectively?