GTU
Electronics Engineering

ELEC 331
Electronic Circuits 2

Fall Semester

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HW 5
Questions

Updated October 20, 2017 - 13:41

Assigned:

Due:

Answers Out:

Late Due:

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BJT Bias and SCTC

8.19 In Fig. P8.19, $\beta = 200$.
(a) Find I_B so that the transistor is biased at $I_C = 2.5$ mA.
(b) Find the numerical value of r_π.
(c) Write an equation for C so that the low-frequency pole is located at 100 rad/s.

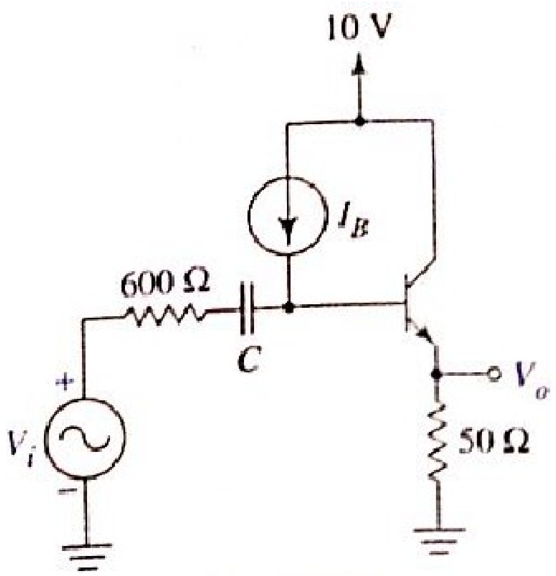


Figure P8.19

Necessary Knowledge and Skills: BJT biasing and small signal equivalent circuit, small signal impedance computations, method of SCTC (short-circuit time constants) for estimating the lower freq. cut off frequency (also interpreted as half-power freq.).

BJT Bias and SCTC

8.20 Use short-circuit time constants to estimate the lower half-power frequency for Fig. P8.20; $\beta = 99$, $r_\pi = 100\ \Omega$.

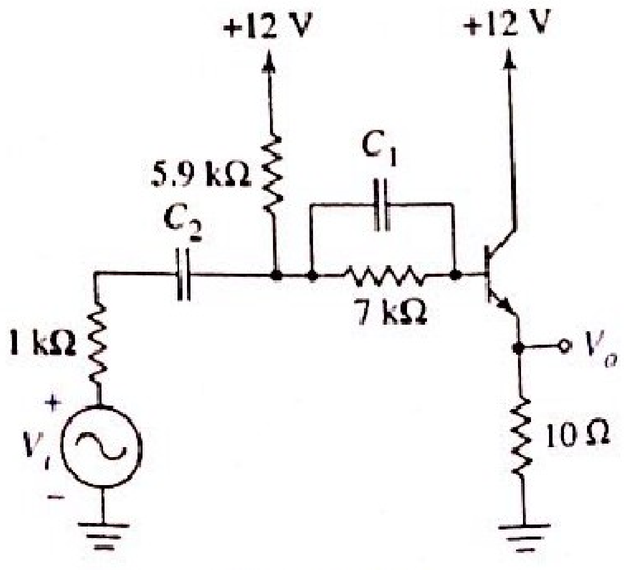


Figure P8.20

Necessary Knowledge and Skills: BJT biasing and small signal equivalent circuit, small signal impedance computations, method of SCTC (short-circuit time constants) for estimating the lower freq. cut off frequency (also interpreted as half-power freq.).

CS Amplifier Frequency Response

4.94 In a particular MOSFET amplifier for which the mid-band voltage gain between gate and drain is –27 V/V, the NMOS transistor has $C_{gs} = 0.3$ pF and $C_{gd} = 0.1$ pF. What input capacitance would you expect? For what range of signal-source resistances can you expect the 3-dB frequency to exceed 10 MHz? Neglect the effect of R_G.

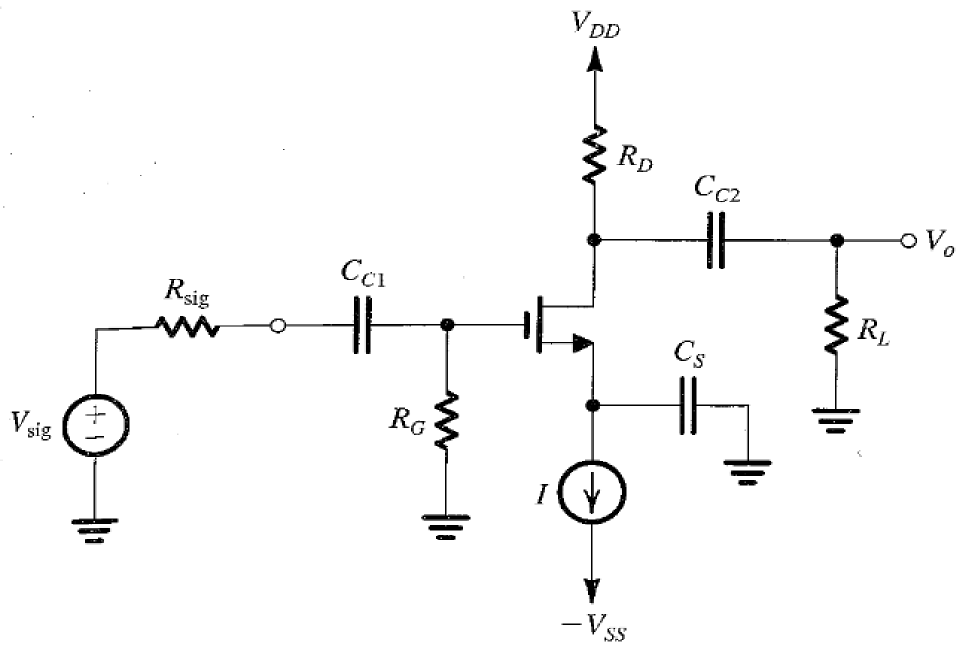
Note: Consider this question as of a common source amplifier configuration.

Additional Tasks: Review Miller's theorem, reprove it on paper.

Necessary Knowledge and Skills: Miller's effect in common source configuration, dominant pole determined by the Miller effect, OCTC method for computing the approximate high freq. cut-off, equivalent Thevenin impedance calculations, design for increasing bandwidth.

CS Amplifier OCTC, SCTC and Miller's Effect

D4.95 In a FET amplifier, such as that in Fig. 4.49(a), the resistance of the source $R_{\text{sig}} = 100\ \text{k}\Omega$, amplifier input resistance (which is due to the biasing network) $R_{\text{in}} = 100\ \text{k}\Omega$, $C_{gs} = 1\ \text{pF}$, $C_{gd} = 0.2\ \text{pF}$, $g_m = 3\ \text{mA/V}$, $r_o = 50\ \text{k}\Omega$, $R_D = 8\ \text{k}\Omega$, and $R_L = 10\ \text{k}\Omega$. Determine the expected 3-dB cutoff frequency f_H and the midband gain. In evaluating ways to double f_H, a designer considers the alternatives of changing either R_{out} or R_{in}. To raise f_H as described, what separate change in each would be required? What midband voltage gain results in each case?



(a)

CS Amplifier OCTC, SCTC and Miller's Effect

Note: This is a common source configuration.

Additional Tasks: Apply the SCTC method for computing the low freq. cut-off, iterate over the AC coupling capacitors, leave results in terms of the parameters used.

Necessary Knowledge and Skills: OCTC methods for computing the high freq cut-off, Thevenin equivalent impedance calculations, small signal equivalent circuits, bandwidth and gain trade-off, gain bandwidth product calculations, Miller's effect.

CE Amplifier OCTC, SCTC and Miller's Effect

5.159 Consider the common-emitter amplifier of Fig. P5.159 under the following conditions: $R_{sig} = 5$ kΩ, $R_1 = 33$ kΩ, $R_2 = 22$ kΩ, $R_E = 3.9$ kΩ, $R_C = 4.7$ kΩ, $R_L = 5.6$ kΩ, $V_{CC} = 5$ V. The dc emitter current can be shown to be $I_E \cong 0.3$ mA, at which $\beta_0 = 120$, $r_o = 300$ kΩ, and $r_x = 50$ Ω. Find the input resistance R_{in} and the midband gain A_M. If the transistor is specified to have $f_T = 700$ MHz and $C_\mu = 1$ pF, find the upper 3-dB frequency f_H.

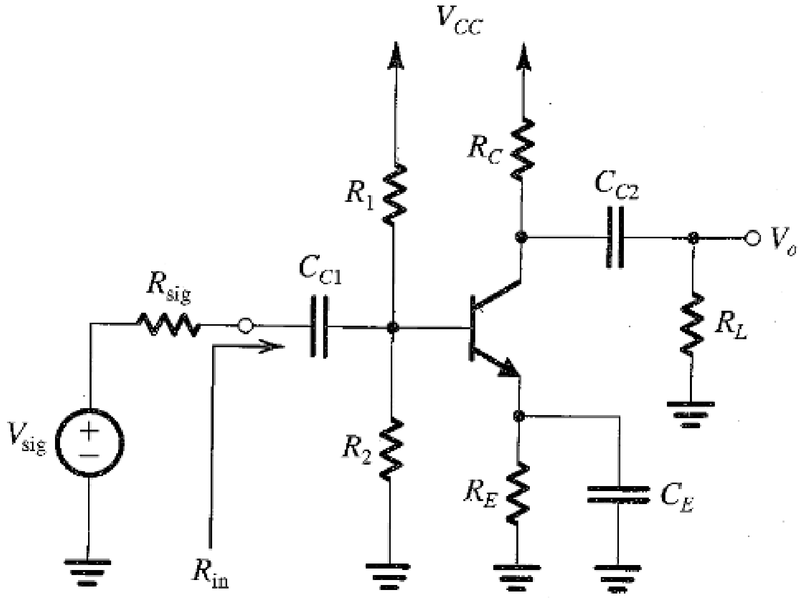


FIGURE P5.159

Notes: This is a common emitter configuration.

Additional Tasks: Apply the SCTC method for computing the low freq. cut-off, iterate over the AC coupling capacitors, leave results in terms of the parameters used.

Necessary Knowledge and Skills: OCTC methods for computing the high freq cut-off, Thevenin equivalent impedance calculations, small signal equivalent circuits, bandwidth and gain trade-off, gain bandwidth product calculations, Miller's effect.

BJT Differential Amplifier High-Freq. Response

7.82 A BJT differential amplifier operating with a 1-mA current source uses transistors for which $\beta = 100$, $f_T = 600$ MHz, $C_\mu = 0.5$ pF, and $r_x = 100\ \Omega$. Each of the collector resistances is 10 kΩ, and r_o is very large. The amplifier is fed in a symmetrical fashion with a source resistance of 10 kΩ in series with each of the two input terminals.

(a) Sketch the differential half-circuit and its high-frequency equivalent circuit.
(b) Determine the low-frequency value of the overall differential gain.
(c) Use Miller's theorem to determine the input capacitance and hence estimate the 3-dB frequency f_H and the gain–bandwidth product.

Notes: None.

Additional Tasks: None.

Necessary Knowledge and Skills: Differential amplifier, half circuit in differential mode, no emitter degeneration, small signal equivalent of BJT, differential voltage midband gain calculation, OCTC, Miller's effect, dominant pole approximation, gain bandwidth product.