

The University of Portland
Donald P. Shiley School of Engineering

EE352
Electronic Circuits II
HOMEWORK 3

Assigned: Mon, Feb 3, 2020
Due: Mon, Feb 10, 2020
Exam 1: Wed, Feb 19, 2020 (closed-book, one crib-sheet, Diff Amp sheet, calculator)

Problems:

1. Using Matlab, sketch and label the Bode Plots for the following transfer function:

$$T(s) = \frac{10^3(1 + s/10^5)}{(1 + s/10^3)(1 + s/10^4)}$$

2. Analyze the CE Amplifier shown in Figure 1 on the next page. Assume the NPN transistor is a 2N3904 and use its data-sheet (attached) as needed.
- Perform full hand DC Analysis showing all DC node voltages and branch currents. Assume $\beta=100$ and $V_{BE-on}=0.7V$. Please label and circle these values directly on your schematic. Is the bias point stable to temperature and β variation ?
 - Perform full hand AC Small-Signal Analysis using the hybrid-pi model in order to calculate the full frequency response of this circuit (i.e., calculate A_m , R_i , R_o , ω_L , ω_H). Assume $\beta=100$ and $h_{oe}=15\mu mhos$. Deduce all hybrid-pi parameters using appropriate hand calculations and/or from the 2N3904 data sheet as needed including C_π , C_μ , etc. You need to do a Mid-Band Frequency Analysis, a High-Frequency Analysis (using OCTC's) and a Low-Frequency Analysis (using SCTC's) as we did in class. Please plot your final Bode Plots (both Magnitude and Phase) highlighting the Mid-Band Gain, A_m , along with ω_L and ω_H .
 - Calculate the transistor's unity gain frequency, f_t , at the operating point of the CE circuit.
 - Calculate the transistor's Early Voltage, V_A , at the operating point of the CE circuit.
 - Repeat a) and b) in PSPICE using AC Sweep Analysis with Bias Point Details turned on. Set AC Sweep Type to Decade, set Pts/Decade=10, set Start Freq=1 and set End Freq=1000MEG. Use QbreakN3 NPN transistor and edit its model as follows: (BF=100 TF=500E-12 CJC=4E-12 MJC=0 CJE=8E-12 MJE=0 VAF=<use your value from part d above>). Please turn in your *properly labeled* PSPICE schematic, abbreviated xxx.out file and Bode Plot printouts (as usual). Note that your xxx.out file gives all of the PSPICE calculated DC analysis plus AC parameters such as C_π , C_μ and f_t , etc which you can directly compare to your hand-calculations. NOTE: You won't be able to determine R_i and R_o from PSPICE, so you won't be able to compare these two parameters.

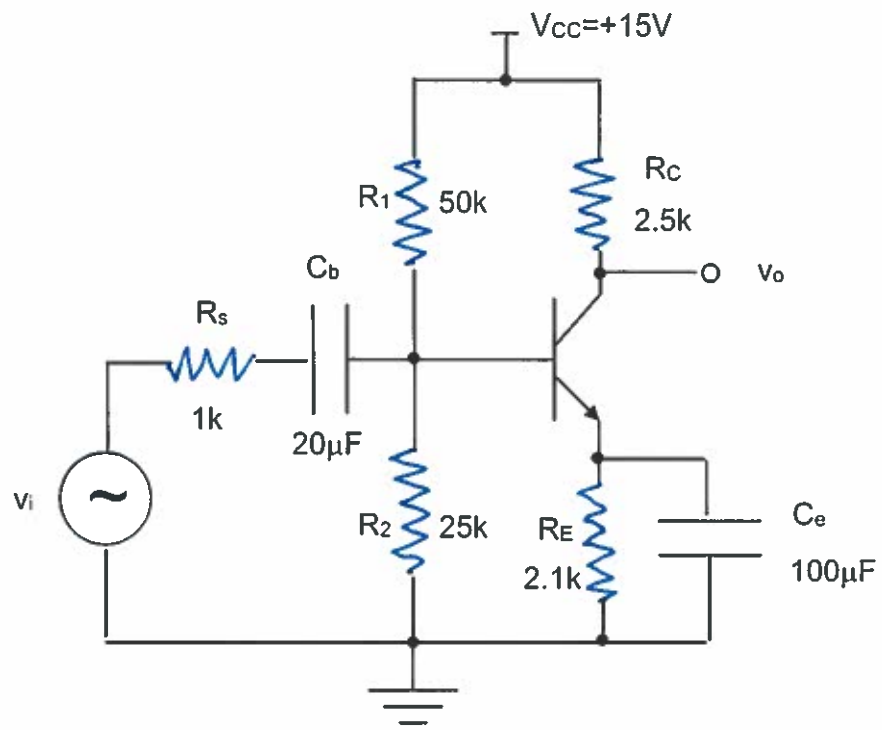


Figure 1.