GTU
Electronics Engineering

ELEC 331
Electronic Circuits 2

Fall Semester

Instructor: Assist. Prof. Önder Şuvak

HW 4
Questions

Updated October 20, 2017 - 13:40

Assigned:

Due:

Answers Out:

Late Due:

Contents

Transfer Function – High Frequency Response

6.40 Consider an amplifier whose $F_H(s)$ is given by

$$F_H(s) = \frac{1}{\left(1 + \frac{s}{\omega_{P1}}\right)\left(1 + \frac{s}{\omega_{P2}}\right)}$$

with $\omega_{P1} < \omega_{P2}$. Find the ratio ω_{P2}/ω_{P1} for which the value of the 3-dB frequency ω_H calculated using the dominant-pole approximation differs from that calculated using the root-sum-of-squares formula (Eq. 6.36) by:

(a) 10%.
(b) 1%.

$$\omega_H \cong 1 \Bigg/ \sqrt{\left(\frac{1}{\omega_{P1}^2} + \frac{1}{\omega_{P2}^2} + \cdots\right) - 2\left(\frac{1}{\omega_{Z1}^2} + \frac{1}{\omega_{Z2}^2} + \cdots\right)} \qquad (6.36)$$

Necessary Knowledge and Skills: Bode plots, transfer functions, poles and zeros, dominant pole approximation, half-power or cut-off or corner or -3 dB frequency, root sum of squares formula and derivation

Transfer Function – High frequency Response

6.41 The high-frequency response of a direct-coupled amplifier having a dc gain of −100 V/V incorporates zeros at ∞ and 10^6 rad/s (one at each frequency) and poles at 10^5 rad/s and 10^7 rad/s (one at each frequency). Write an expression for the amplifier transfer function. Find ω_H using:

(a) the dominant-pole approximation.

(b) the root-sum-of-squares approximation (Eq. 6.36).

If a way is found to lower the frequency of the finite zero to 10^5 rad/s, what does the transfer function become? What is the 3-dB frequency of the resulting amplifier?

$$\omega_H \cong 1 \Big/ \sqrt{\left(\frac{1}{\omega_{P1}^2} + \frac{1}{\omega_{P2}^2} + \cdots\right) - 2\left(\frac{1}{\omega_{Z1}^2} + \frac{1}{\omega_{Z2}^2} + \cdots\right)} \qquad (6.36)$$

Necessary Knowledge and Skills: Bode plots, transfer functions, poles and zeros, dominant pole approximation, half-power or cut-off or corner or -3 dB frequency, root sum of squares formula and derivation

Magnitude Bode Plot

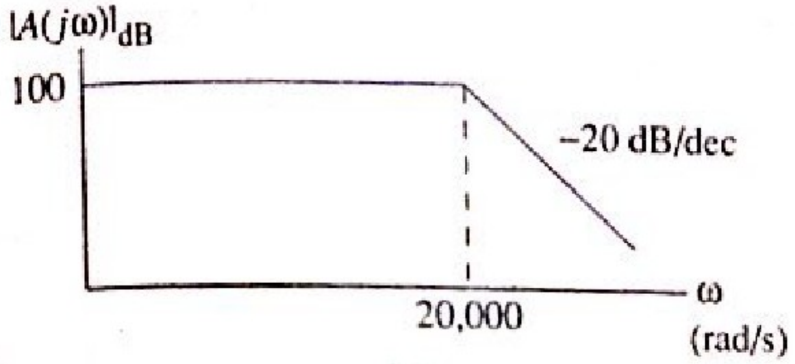
8.4 Estimate the gain in dB at

(a) 10,000 rad/s for Fig. P8.3d.

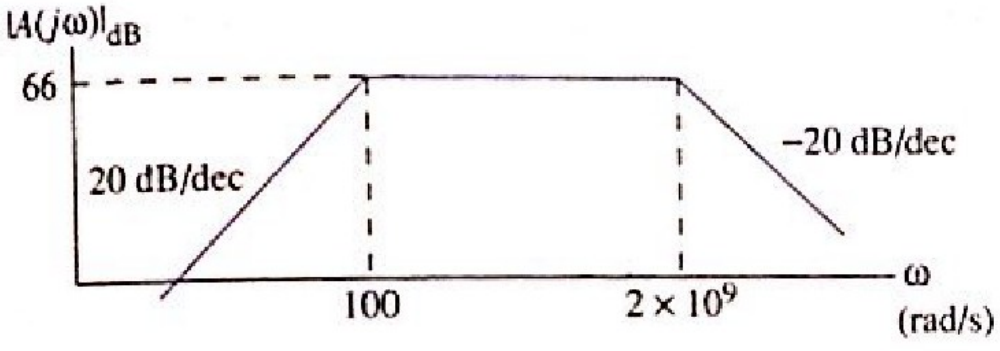
(b) 4000 rad/s for Fig. P8.3d.

(c) 30,000 rad/s for Fig. P8.3a.

(d) 100,000 rad/s for Fig. P8.3d.



(a)



(b)

Magnitude Bode Plot

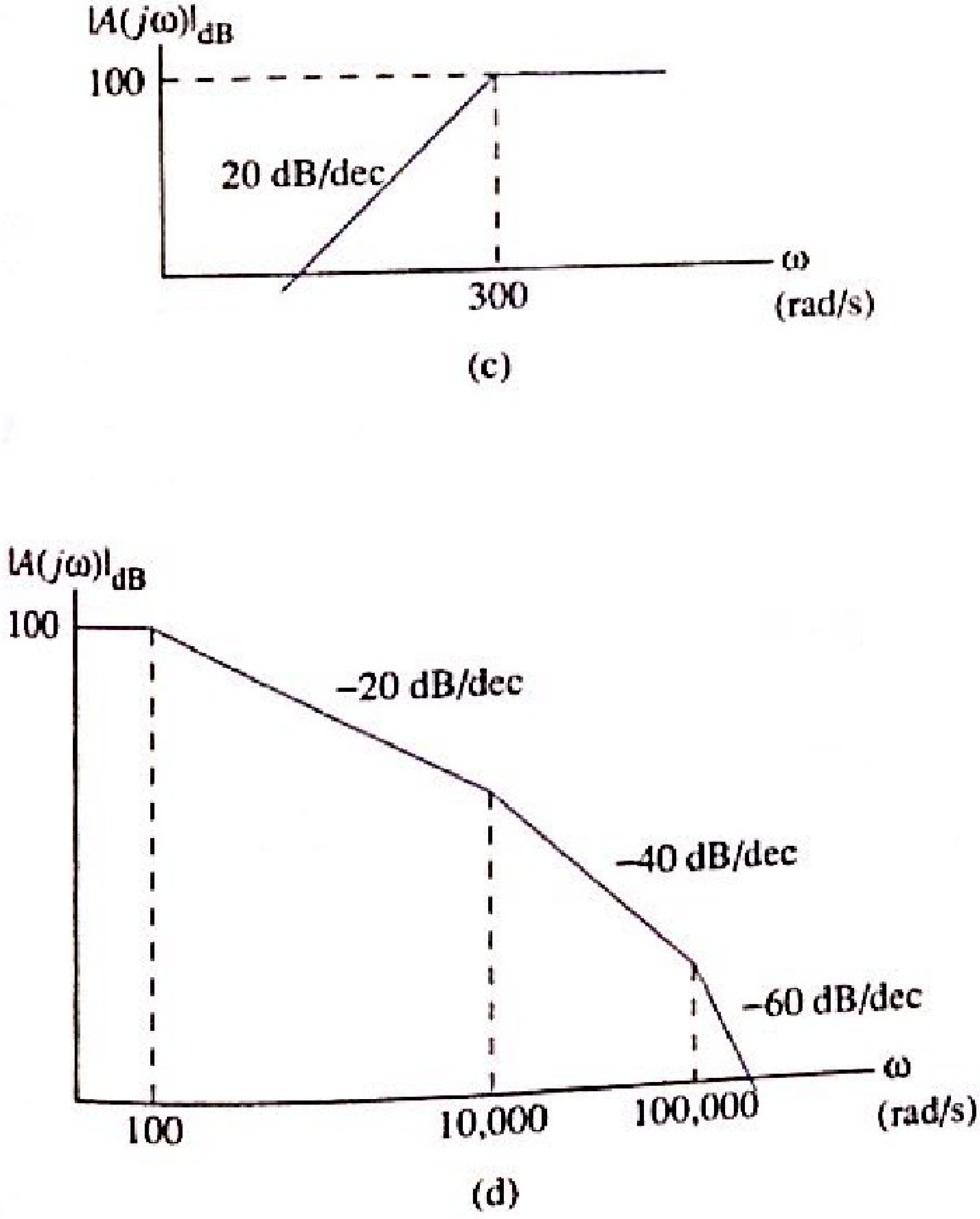


Figure P8.3

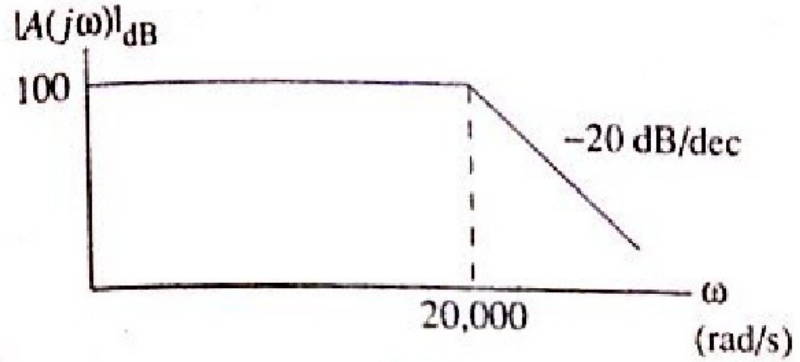
Magnitude Bode Plot

Necessary Knowledge and Skills: Bode plots, transfer functions, poles and zeros, half-power or cut-off or corner or -3 dB frequency, transfer function derivation from Bode plots, slope interpretations in Bode plots

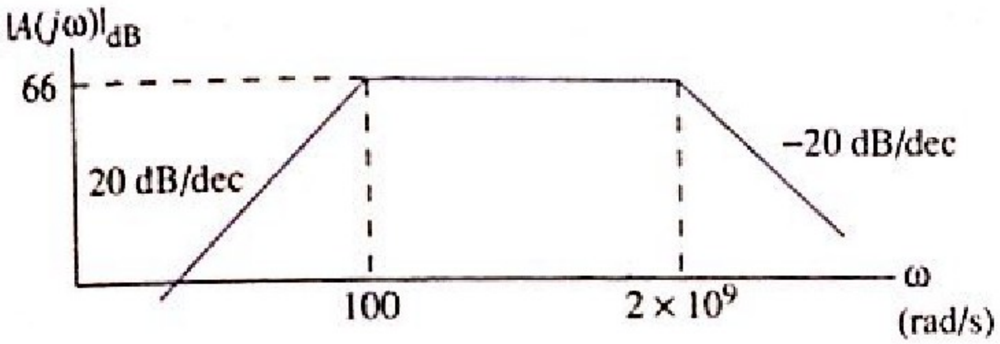
Additional task: Derive the transfer function corresponding to each of the given magnitude Bode plots.

Magnitude Bode Plot

8.5 Estimate the radian frequency where the gain is 0 dB for
(a) Fig. P8.3a.
(b) Fig. P8.3c.
(c) Fig. P8.3d.



(a)



(b)

Magnitude Bode Plot

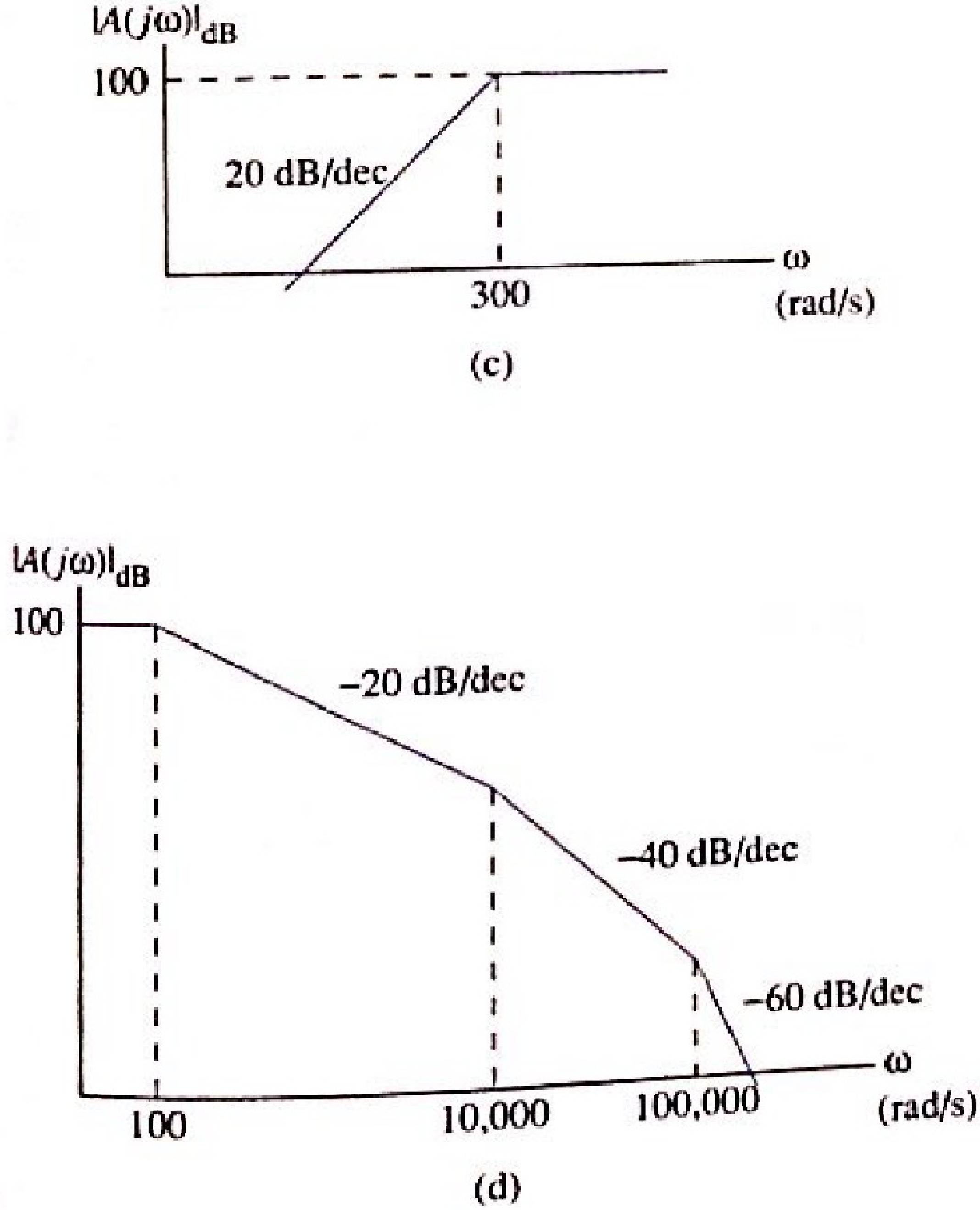


Figure P8.3

Magnitude Bode Plot

Necessary Knowledge and Skills: Bode plots, transfer functions, poles and zeros, half-power or cut-off or corner or -3 dB frequency, slope interpretations in Bode plots

Corner Frequency by OCTC

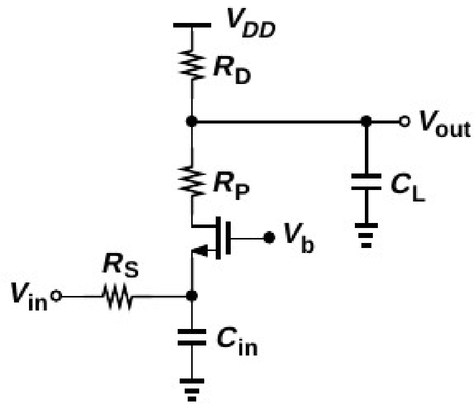


Figure 11.66

Assume the capacitors are small valued, comparable to the internal capacitances of the transistor. Compute the 3dB corner frequency by the OCTC method.

Necessary Knowledge and Skills: Open Circuit Time Constants (OCTC) method for approximating the high frequency cut-off point, small signal equivalent circuit for MOS, small signal impedance computations

Corner Frequency by OCTC

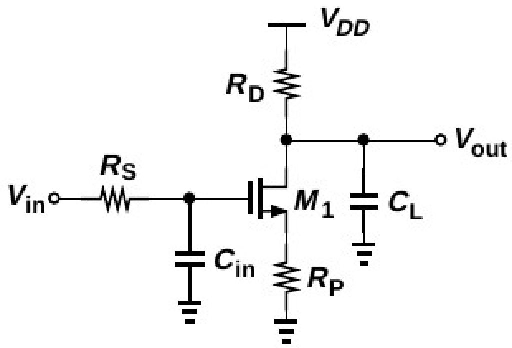


Figure 11.67

Assume the capacitors are small valued, comparable to the internal capacitances of the transistor. Compute the 3dB corner frequency by the OCTC method.

Necessary Knowledge and Skills: Open Circuit Time Constants (OCTC) method for approximating the high frequency cut-off point, small signal equivalent circuit for MOS, small signal impedance computations