Seat No.:_____

King Mongkut's University of Technology Thonburi
Final Exam of Second Semester, Academic Year 2007

CPE 223 Circuit and Electronics for Computer Engineers **CPE(Inter.), 2nd Yr.**

Wednesday 5 March 2008 **13.00-16.00 h.**

Instructions

1. This examination contains 7 problems, 9 pages (including this cover page).
2. The answers must be written in the space provided.
3. Students are allowed to use **calculator**.
4. **Books**, **notes**, and **dictionary** are **NOT** allowed.

Students must raise their hand to inform to the proctor upon their completion of the examination, to ask for permission to leave the examination room.
Students must not take the examination and the answers out of the examination room.

Students will be punished if they violate any examination rules. The highest punishment is dismissal.

This examination is prepared by

Asst. Prof. Sanan Srakaew

Tel. 0-2470-9254

This examination paper is approved by Computer Engineering Department.

Student Name: _____ I.D.: _____

1. Given the Figure 1. Fill in the blanks.

(a) V_{BE} = _____ V

(b) $I_C = \beta I_B$, $I_E = (\beta + 1)I_B$.

Write an equation for I_B and determine I_B

_____

_____

_____

I_B = _____ μA

(c) I_C = _____ mA

(d) I_E = _____ mA

(e) V_E = _____ V

(f) V_C = _____ V

(g) V_{CE} = _____ V

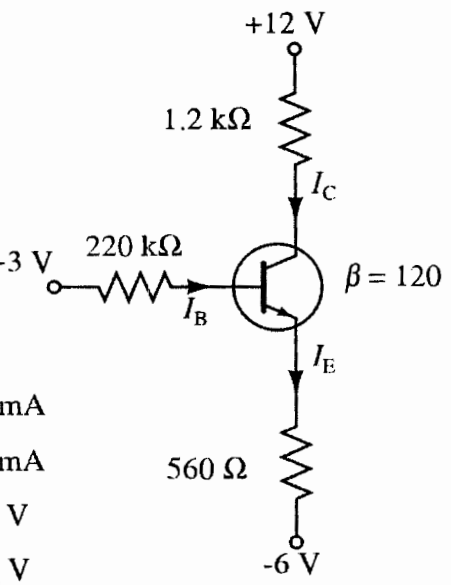


Figure 1

(4 points)

2. Given the Figure 2.
   (a) Explain how to determine I_B and find I_B.
   (b) Explain how to determine r_e.
   (c) Given $r_e = 8.7\ \Omega$, sketch an equivalent circuit using r_e-model.
   (d) Determine Z_i, Z_o and A_V. (6 points)

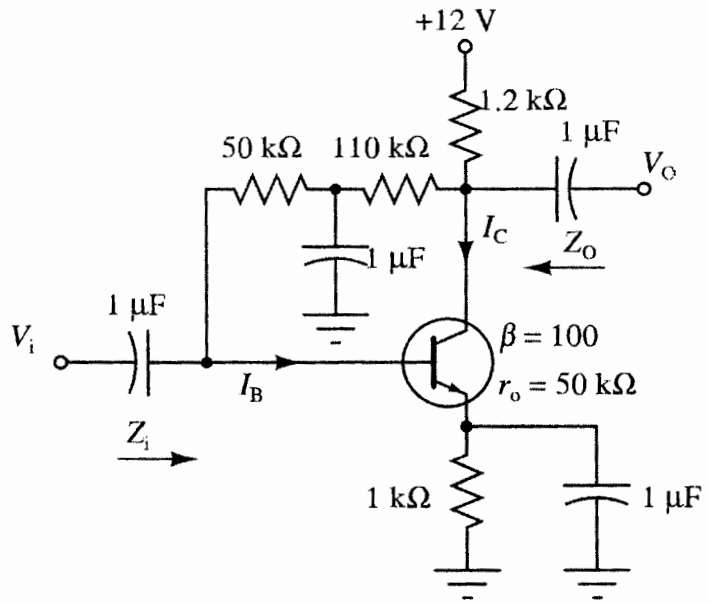


Figure 2

Answer:

3. Given the Figure 3, $\frac{R_2}{R_1}=10$, $f_1=\frac{1}{2\pi R_1 C_1}=1$ kHz, and $f_2=\frac{1}{2\pi R_2 C_2}=10$ kHz.

(a) Write an equation for $V_i(f)$ in term of I_1.

(b) Write an equation for $V_o(f)$ in term of I_2.

(c) Verify that $\frac{V_o(f)}{V_i(f)}=-\frac{R_2}{R_1}\left(\frac{1}{\left(1+j\frac{f}{f_2}\right)\left(1-j\frac{f_1}{f}\right)}\right)$

(d) Using Bode plot, sketch the frequency response, $\frac{V_o(f)}{V_i(f)}$ (only the magnitude).

(8 points)

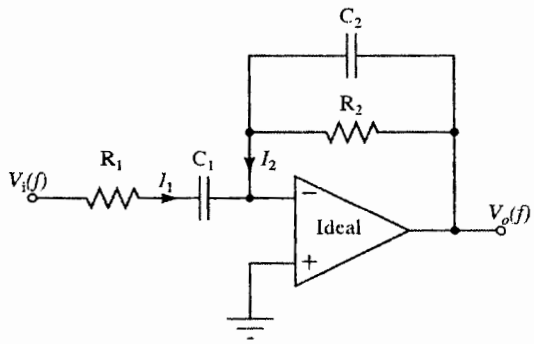
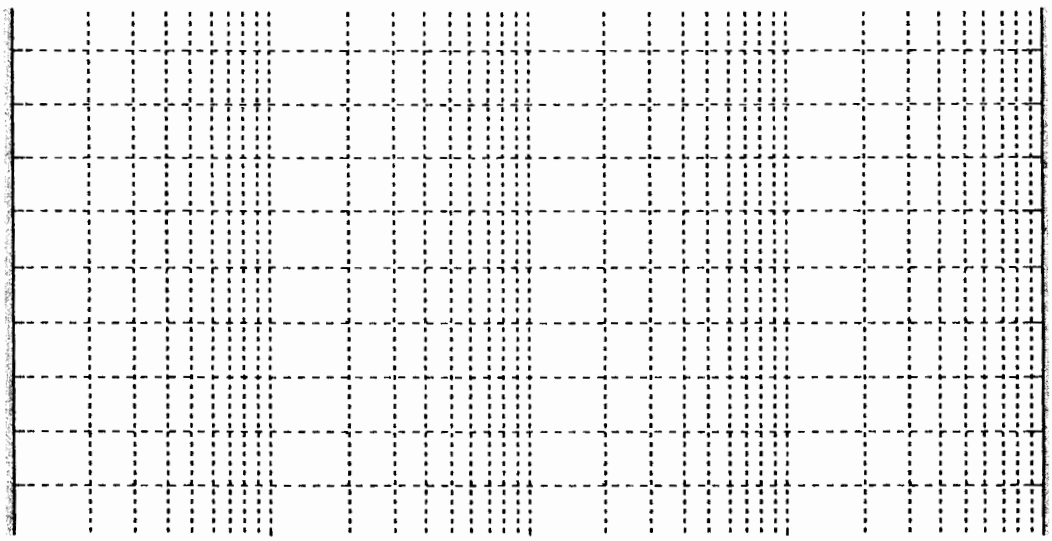


Figure 3

Answer:



4. Determine V_L and I_L. (4 points)

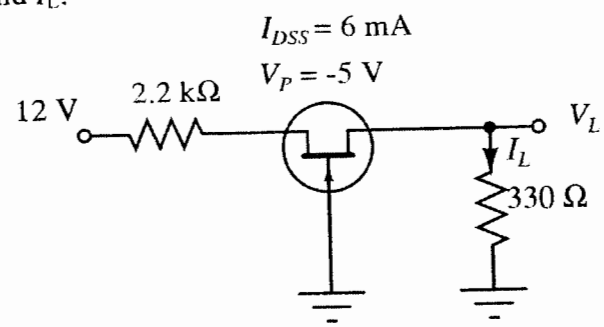


Figure 4

Hint: $I_L = I_{DQ} = I_{DSS}\left(1 - \frac{V_{GSQ}}{V_P}\right)^2$

Answer:

5. Given the Figure 5.
   (a) Determine r_e.
   (b) Determine Z_i.
   (c) Determine the cutoff frequency due to C_S, f_{LS}.
   (d) Determine the cutoff frequency due to C_C, f_{LC}.
   (e) Determine the cutoff frequency due to the bypass capacitor C_E, f_{LE}.
   (f) Sketch the low-frequency response using Bode plot (only the magnitude plot). (6 points)

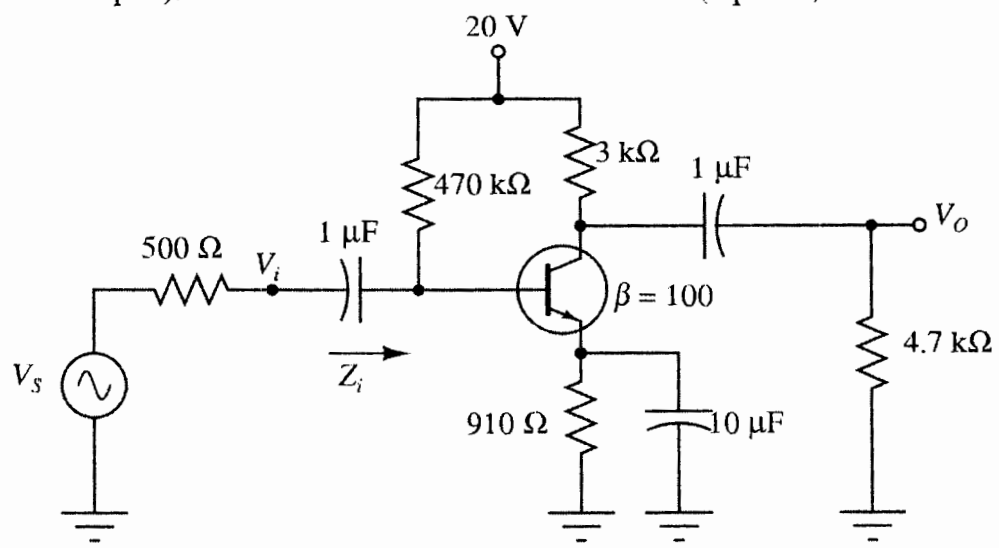
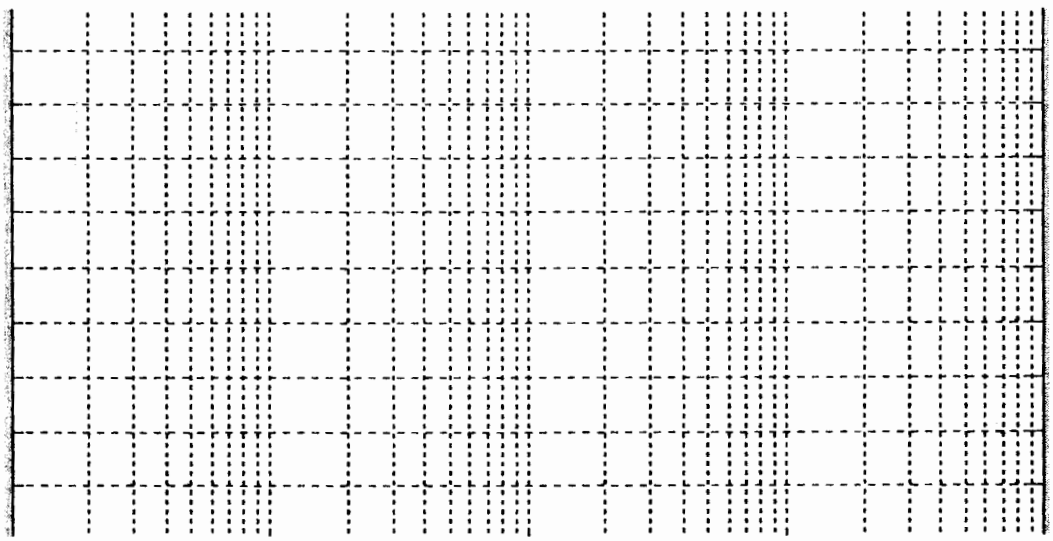


Figure 5

Answer:

Answer(Cont'd):



6. Given the Figure 6, and $\frac{R_2}{R_1} = 10$, determine V_1 and V_O. (2 points)

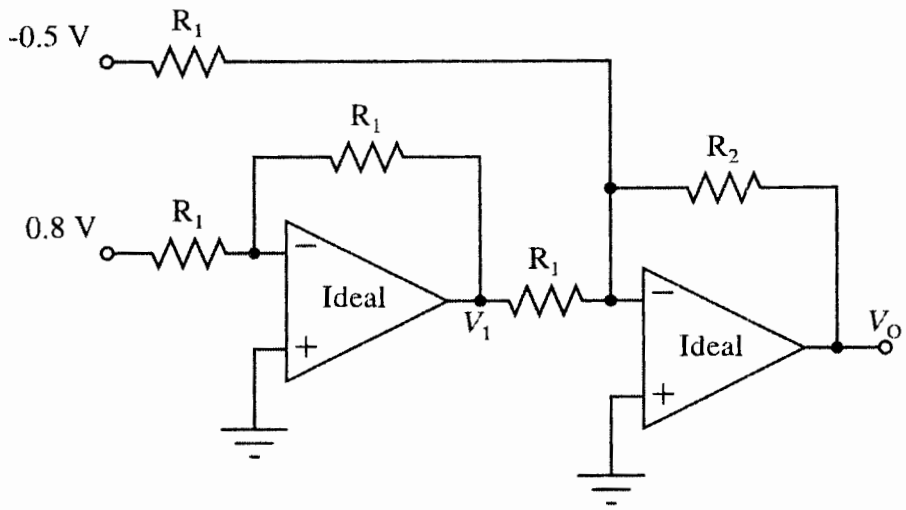


Figure 6

Answer:

7. A series resonance is a circuit containing resistor, capacitor, and inductor. The frequency at which the capacitive reactance $X_C = 1/\omega C$ and the inductive reactance $X_L = \omega L$ are equal is called the *resonant frequency*. At resonant frequency, the input impedance of the circuit $Z_i = R$ and the phase response = 0°. Give at least five issues to be discussed in order to determine resonant frequency of the circuit. (5 points)

Answer:

Supplemental

L, C

$X_C = 1/(2\pi fC)$

$X_L = 2\pi fL$

BJT

DC Analysis

$V_{BE} = 0.7$ V.

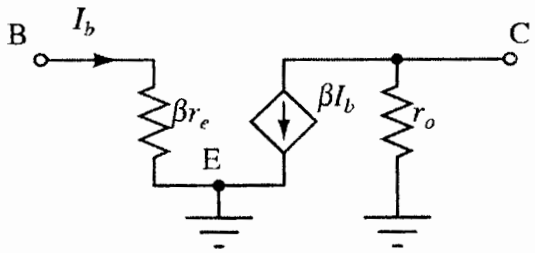
$I_C = \beta I_B$

$I_E = (\beta+1)\, I_B$

$r_e = 26\ \text{mV}/I_E$

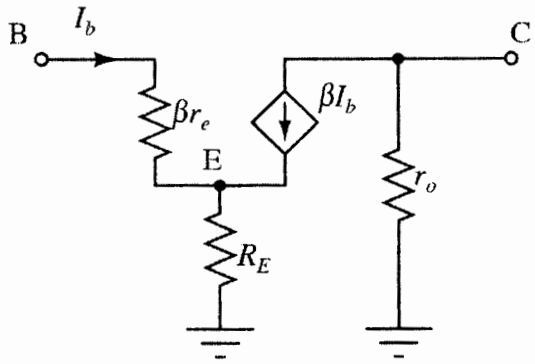
AC Analysis

Common Emitter r_e-model (Emitter bypassed):



$A_v = V_o/V_i = -Z_o/r_e$

Common Emitter r_e-model (Emitter unbypassed):



$A_v = V_o/V_i \approx -R_C/R_E$

Frequency Response

$$f_{LS} = \frac{1}{2\pi(R_S + R_i)C_S}$$

$$f_{LC} = \frac{1}{2\pi(R_O + R_L)C_C}$$

$$f_{LE} = \frac{1}{2\pi R_e C_E},\ R_e = R_E \left\| \left(\frac{R_S \,\|\, R_B}{\beta} + r_e \right) \right.$$

Op-Amp:

Inverting Amp: $V_o/V_i = -Z_F/Z_i$

Noninverting Amp: $V_o/V_i = 1 + Z_F/Z_i$

Summing Amp: $V_o/V_i = -(Z_F/Z_i)(V_1 + V_2 + V_3)$