Seat No.: ________

King Mongkut's University of Technology Thonburi
Final Exam of First Semester, Academic Year 2015

CPE 221 Circuit and Electronics for Computer Engineers **CPE(Inter.)**

Monday 30 November 2015 **13.00-16.00 h.**

Instructions

1. This examination contains 6 problems, 9 pages (including this cover page). The total score is 35 points.
2. Show all steps to the solution and put the final answer in the answer box. Work on the solution in the space provided.
3. Students are allowed to use a **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

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Tel. 0-2470-9254

This examination paper is approved by Computer Engineering Department.

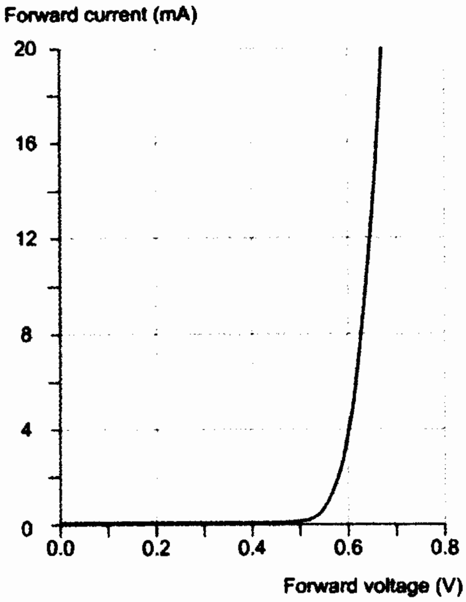
Problems	1	2	3	4	5	6
Points	4	5	6	10	6	4
Points earned						

Student Name: ____________________ I.D.: ______________

1. Given the diode characteristic below:

(a) Sketch the load line and determine v_D and i_D of the circuit in Fig 1.

(4 points)



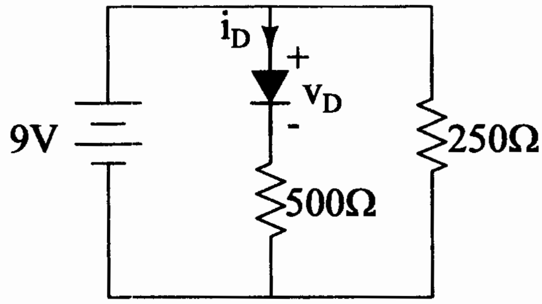


Fig. 1

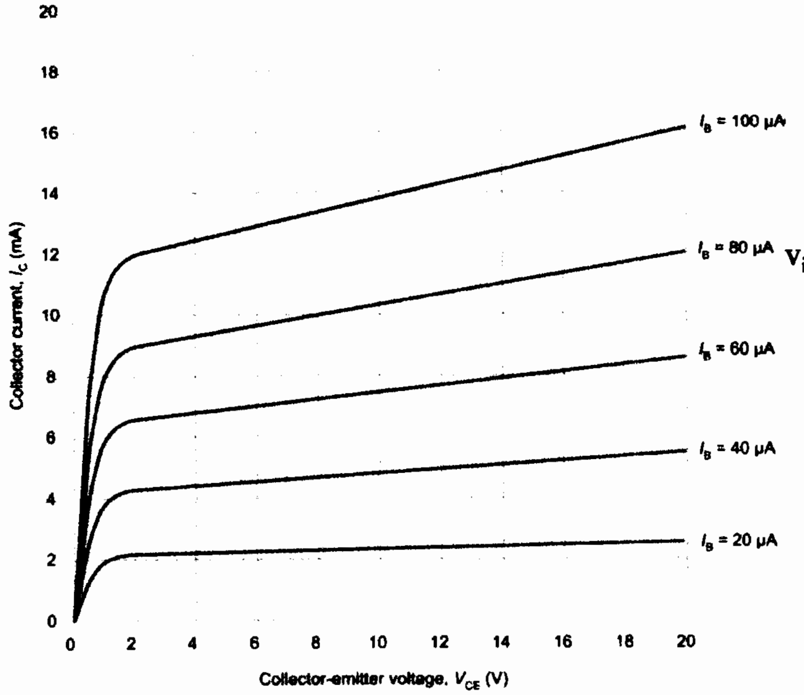
Use this space to work on the problem and put the answers in the answer boxes:

Answer box	
i_D	
v_D	

(b) Determine and sketch the diode model (find V_T and R_F)

Answer box	
V_T	
R_F	

2. Given the BJT characteristic below and the circuit in Fig 2, determine I_{Cmax}, V_{CEmax}, and sketch the load line. Determine β, I_{BQ}, V_{CEQ}, I_{CQ}, and locate the Q-point. (5 points)



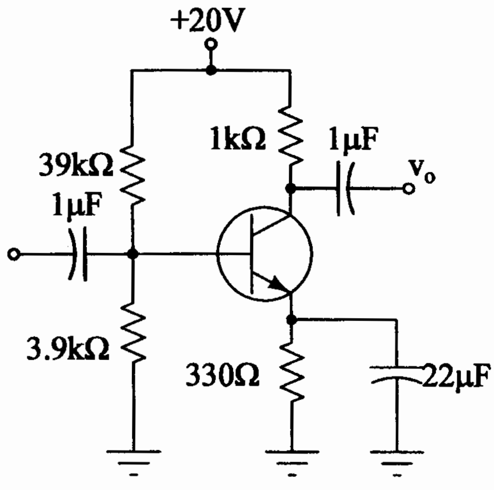


Fig. 2.

Use this space to work on the problem and put the answers in the answer box:

Answer box	
V_{CEmax}	
I_{Cmax}	
β	
I_{BQ}	
I_{CQ}	
V_{CEQ}	

3. Given $V_{BE} = 0.7$ V. Determine (6 points)

(a) I_{EQ}

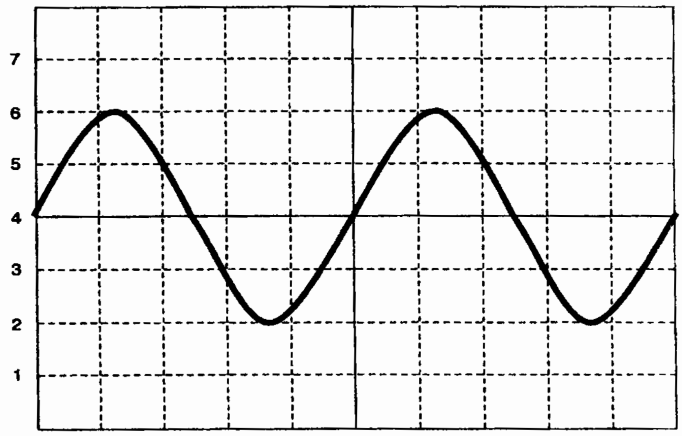
(b) r_e

(c) Z_i

(d) Z_o

(e) A_v

(f) If $v_i = 10 \sin 2000\pi t$ mV, as shown, sketch the output waveform v_o.



Volts/Div.: CH1: 5mV CH2: 1V Time/Div.: 200μs

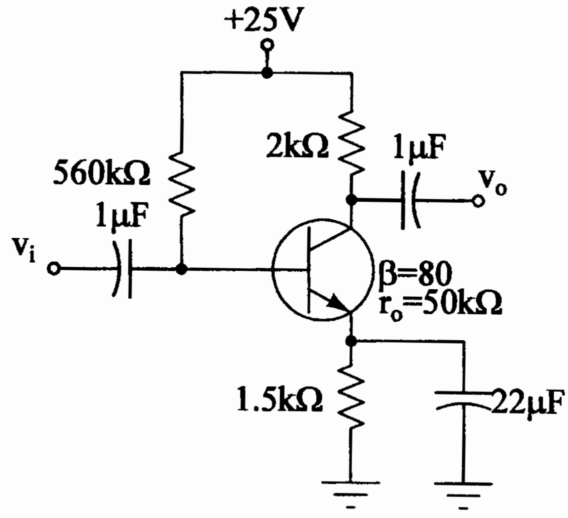


Fig. 3.

Use this space to work on the problem and put the answers in the answer box:

Answer box	
I_{EQ}	
r_e (Ω)	
Z_i (Ω)	
Z_o (Ω)	
A_v	

4. For the circuit of Figure 4: (10 points)

a) Determine r_e.
b) Find Av = Vo/Vi and Av in dB.
c) Calculate Zi.
d) Find Av_S = Vo/V_S and Av_S in dB.
e) Determine f_{Ls}, f_{Lc}, and f_{LE}.
f) Sketch the Bode plot defined by the cutoff frequencies of part (e).
g) Sketch the low-frequency response of the amplifier using the result of part (f)
h) Determine the low cutoff frequency (f_C) of part (g).

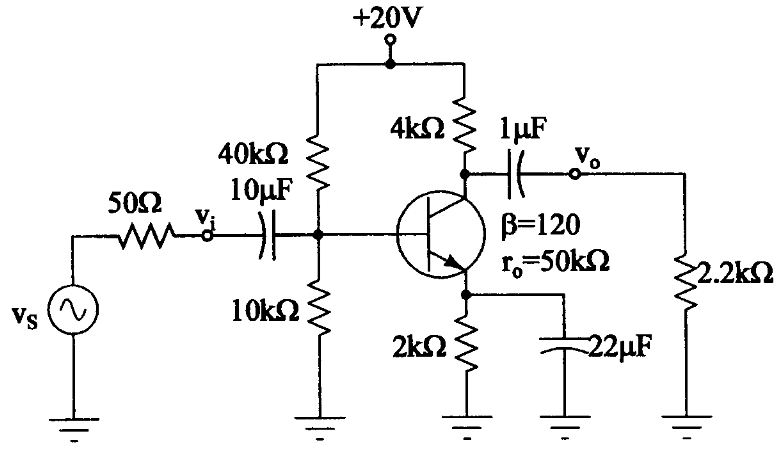
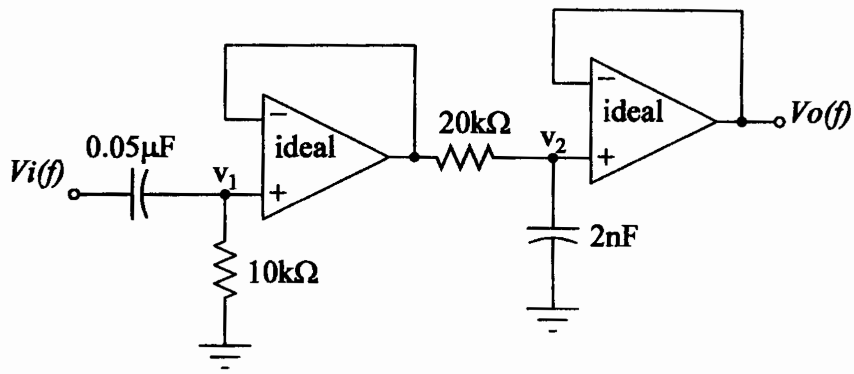


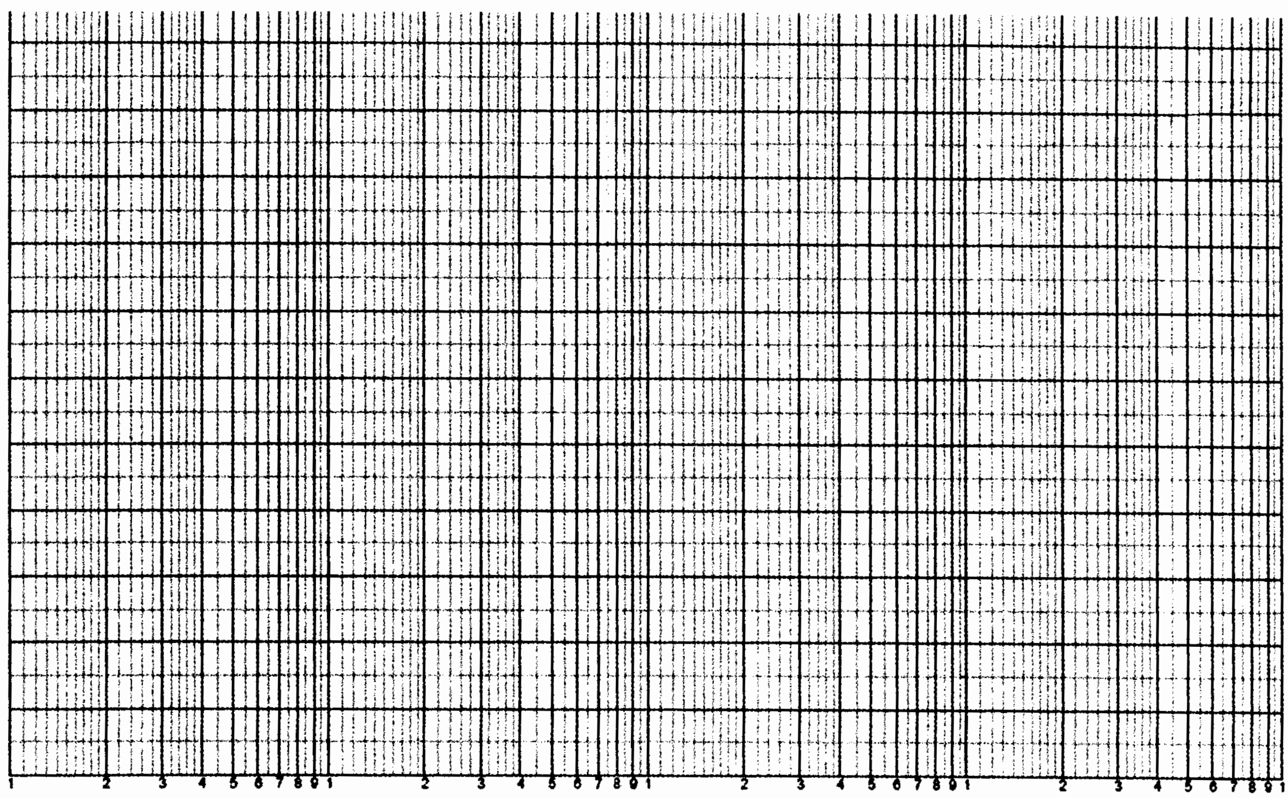
Fig. 4

Use this space to work on the problem and put the answers in the answer box:

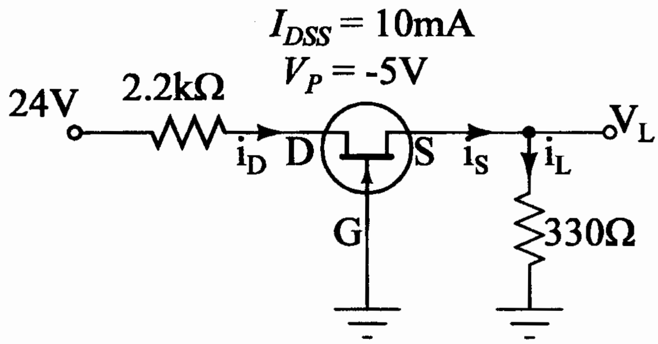
Answer box	
r_e (Ω)	
Av	
Av (dB)	
Z_i (Ω)	
Av_S	
Av_S (dB)	
f_{Ls} (Hz)	
f_{Lc} (Hz)	
f_{LE} (Hz)	
f_C (Hz)	

5. For the circuit of the Figure 5 below, determine *Vo*(*f*)/*Vi*(*f*) and sketch the frequency response. Is the circuit a LPF, HPF, or BPF? Determine the cut-off frequency(frequencies). (6 points)





6. For the circuit of the Figure 6 below, determine the voltage V_L and current I_L. (4 points)



Use this space to work on the problem and put the answers in the answer boxes:

Answer box	
V_L	
i_L	

Supplemental

Frequency response analysis of CE amplifier:

$$\boxed{R_{Th} = R_1 \| R_2}$$

$$\boxed{A_v = \frac{V_o}{V_i} = \frac{-R_L || R_o}{r_e}}$$

$$\boxed{E_{Th} = V_{R_2} = \frac{R_2 V_{CC}}{R_1 + R_2}}$$

$$\boxed{A_{v_s} = \frac{V_i}{V_s}\frac{V_o}{V_i} = \frac{R_i}{R_i + R_s} A_v}$$

$$\boxed{I_B = \frac{E_{Th} - V_{BE}}{R_{Th} + (\beta + 1)R_E}}$$

$$\boxed{f_{L_s} = \frac{1}{2\pi(R_s + R_i)C_s}}$$

$$\boxed{I_E = (\beta + 1)I_B}$$

$$\boxed{f_{L_C} = \frac{1}{2\pi(R_o + R_L)C_C}}$$

$$\boxed{R_o = R_C \| r_o}$$

$$\boxed{r_e = \frac{26mV}{I_E}}$$

$$\boxed{f_{L_E} = \frac{1}{2\pi R_e C_E}}$$

$$R_e = R_E \left\| \left(\frac{R'_s}{\beta} + r_e \right) \right.$$

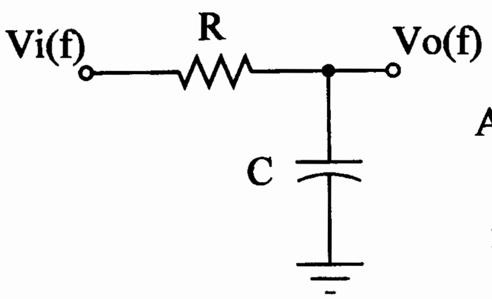
$$Z_i = R_i = R_1 || R_2 || \beta r_e$$

$$R'_s = R_s \| R_1 \| R_2$$

Shockey's Equation of JFET:

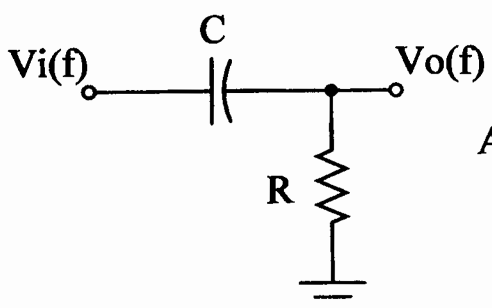
$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

RC Networks



$$Av = \frac{1}{1 + j(f/fc)}$$

$$fc = \frac{1}{2\pi RC}$$



$$Av = \frac{1}{1 - j(fc/f)}$$

$$fc = \frac{1}{2\pi RC}$$