AMERICAN UNIVERSITY OF SCIENCE & TECHNOLOGY

FACULTY OF ENGINEERING
DEPARTMENT OF COMPUTER AND COMMUNICATIONS ENGINEERING

CCE 301: ELECTRONICS

Spring Term 2013-2014

Exam No.4

May 22, 2014

**Student Name:** _____   **ID Number:** _____

CLOSED BOOK (75 Minutes)

- The **cheating** penalty will result in a **zero**
- **Cellular Phones** are strictly prohibited in the examination hall.
- **Borrowing** of any material is not permissible.
- Write your name and ID number in the indicated space of the question booklet.
- You may use the back of any page for scratch.
- Do not detach any scratch sheet from the question booklet.
- This exam contains 12 pages (including this cover page) and 4 problems. Check to see if any pages are missing. Print your name on the top of this page, and put your initials on the top of every page, in case the pages become separated.

Problem	Points	Score
1	20	
2	25	
3	25	
4	30	
Total:	100	

1. (20 points) **N-Channel JFET Voltage Divider Bias Design.**
   Consider the following voltage divider n-channel JFET. Consider the following transistor
   parameters: $I_{DSS} = 12mA$, $V_p = -3.5V$. Let $R_1 + R_2 = 100k\Omega$. Design the circuit such
   that the dc drain current is $I_D = 5mA$ and the dc drain-to-source voltage is $V_{DS} = 5V$.
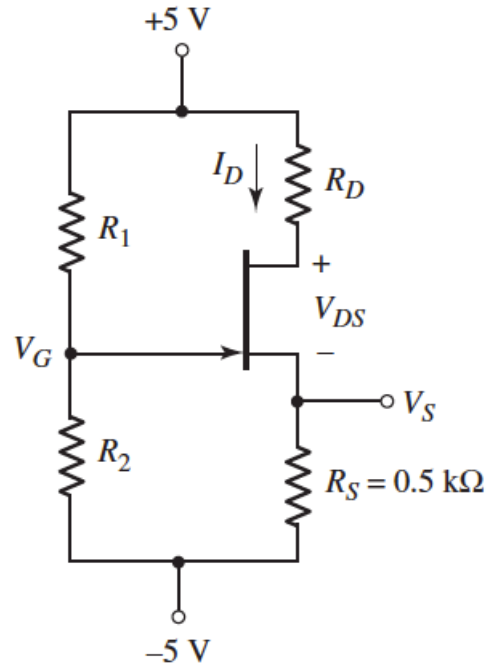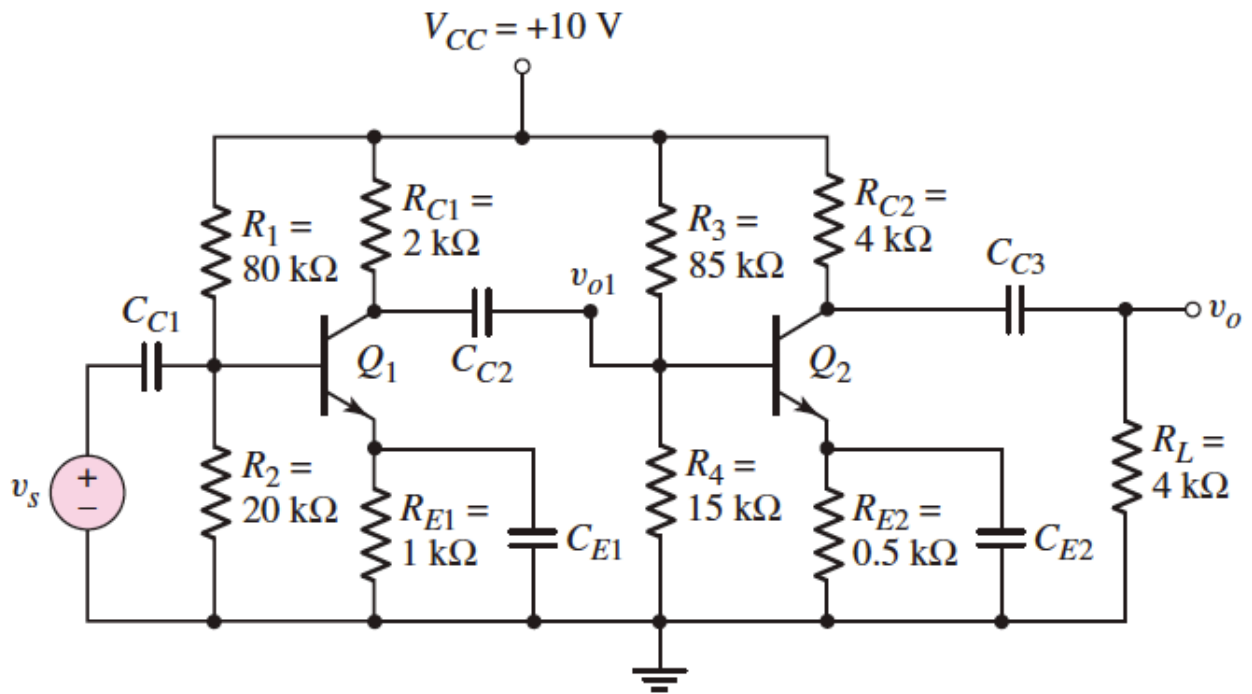
2. (25 points) **Emitter-Follower Amplifier.**
   Consider the following emitter follower amplifier.
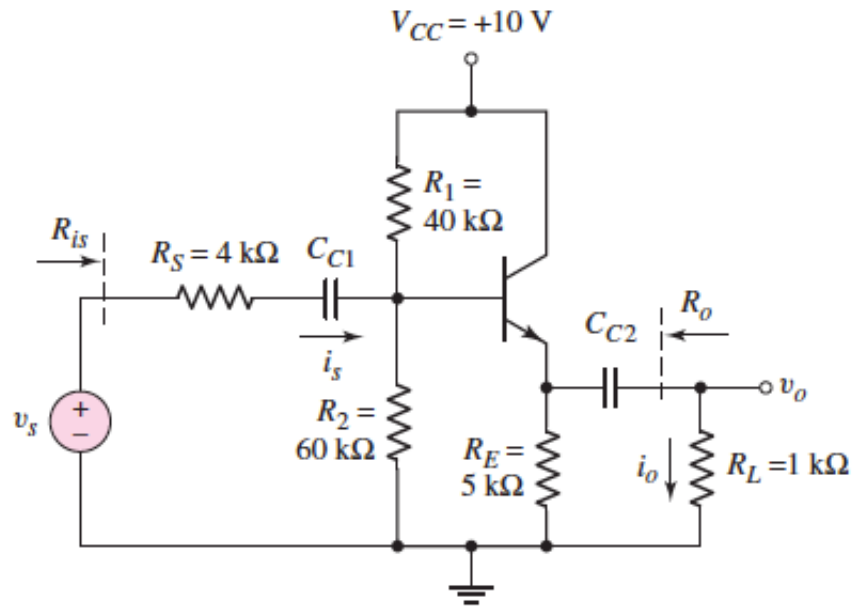
1. (5 points) Draw the small signal model for the amplifier..
2. (10 points) Determine the range of voltage gain A_v if β is in the range $75 \leq \beta \leq 150$.
3. (10 points) Determine the range of current gain A_i if β is in the range $75 \leq \beta \leq 150$.

3. (25 points) **Two-Stage Amplifier.**

Consider the two-stage amplifier circuit, with $\beta_{DC} = \beta_{ac} = 100$ for both amplifiers.

$V_{CC} = +10$ V

$R_1 = 80$ kΩ

$R_{C1} = 2$ kΩ

$R_3 = 85$ kΩ

$R_{C2} = 4$ kΩ

C_{C3}

C_{C1}

Q_1 C_{C2}

Q_2

v_{o1}

v_o

v_s

$R_2 = 20$ kΩ

$R_{E1} = 1$ kΩ

C_{E1}

$R_4 = 15$ kΩ

$R_{E2} = 0.5$ kΩ

C_{E2}

$R_L = 4$ kΩ

1. (10 points) Determine the voltage gain A_{v2} for Q_2.
2. (15 points) Determine the voltage gain A_{v1} for Q_1.
3. (10 points) Find the overall voltage gain A_v for the two-stage amplifier in dB.

4. (30 points) **Variable Gain Amplifier.**

The amplifier shown below has a variable gain control, using a 100 Ω potentiometer for R_E with the wiper ac-grounded. As the potentiometer is adjusted, more or less of R_E is bypassed to ground, thus varying the gain. The total R_E remains constant to dc, keeping the bias fixed.
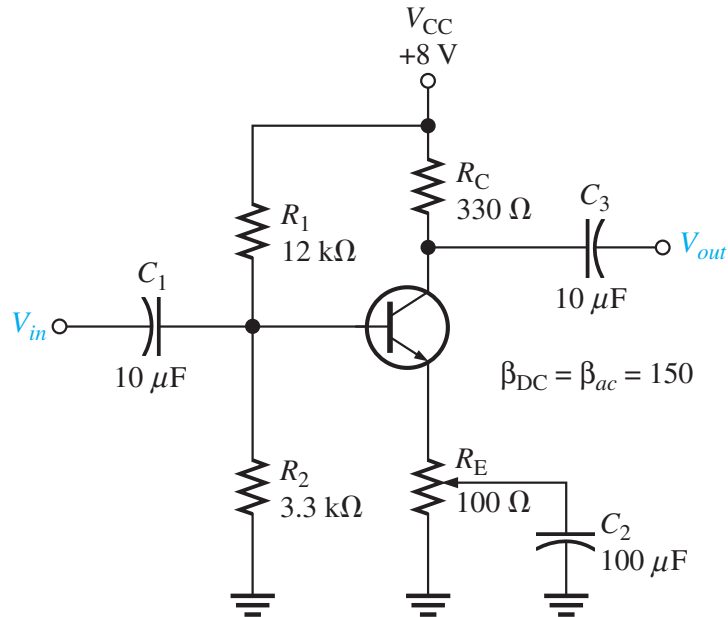
1. (10 points) Find the maximum and the minimum gains for this unloaded amplifier.

2. (10 points) If a load resistance of 600Ω is placed on the output of the amplifier, what are the maximum and minimum gains?

3. (10 points) Find the overall maximum voltage gain for the amplifier with a $1k\Omega$ load if it is being driven by a $300k\Omega$ source.

Bonus (20 points)
Consider the following amplifier. Find R_{in}, A_v, A_i, and A_p.