ECE 137 A Mid-Term Exam

February 15, 2002

Do not open exam until instructed to.

Closed book: Crib sheet and 1 page personal notes permitted

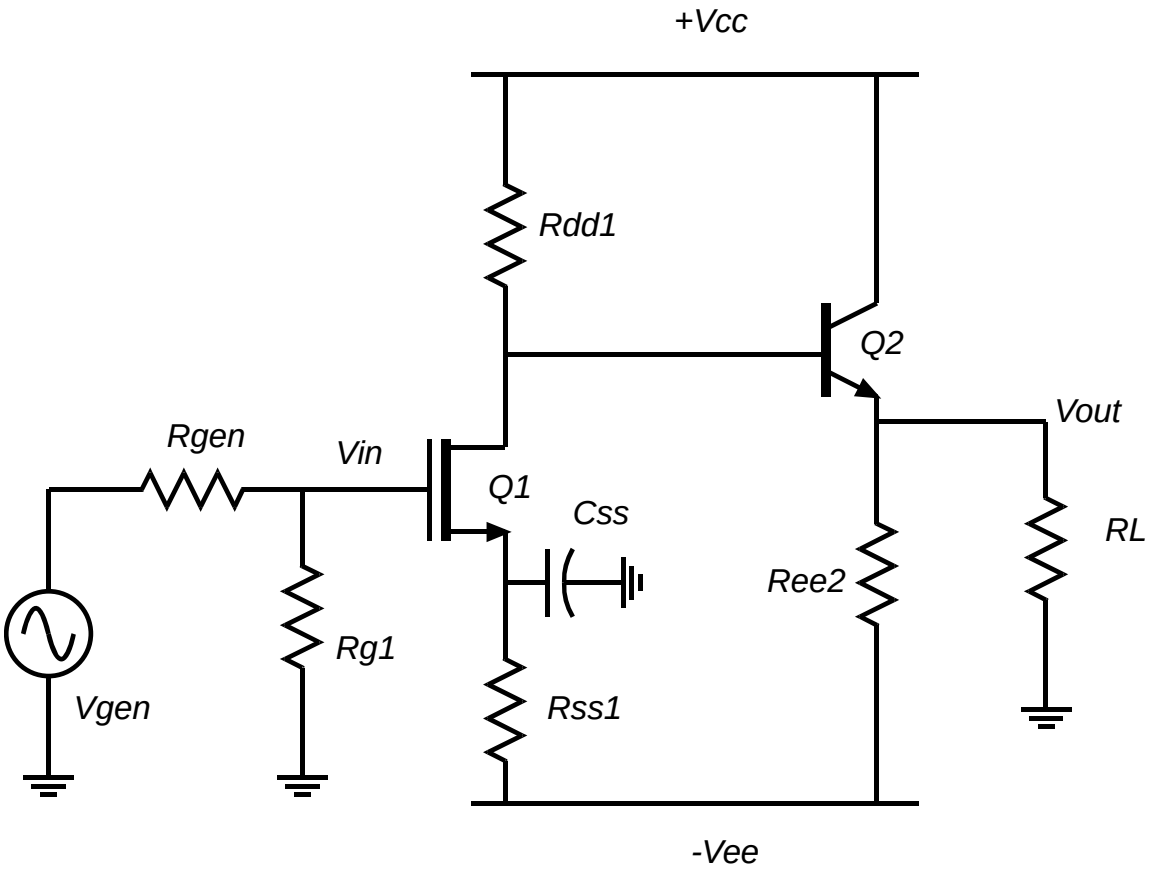
There is one problem on this exam (parts A-F) , and your have 50 minutes.

Use any and all reasonable approximations (5% accuracy is fine.) , ***AFTER STATING THEM.***

Name: _____

Problem 1, 100 points

You will be working on the circuit below:



Q1 : V_{th} =0.5 Volts. $v_{sat}C_{ox}W_g = 3$ mA/V, $\lambda = 1/(20\,Volts)$

Q2: beta=100, Va=200 Volts.

Vcc=+3.3 volts.	-Vee=-3.3 volts	Rgen=1 MegOhm	RL=1000 Ohm
Rg1=10 MegOhm	Rss1= ???	Rdd1= ???	Ree2= ???

Css is very big and has negligible AC impedance.

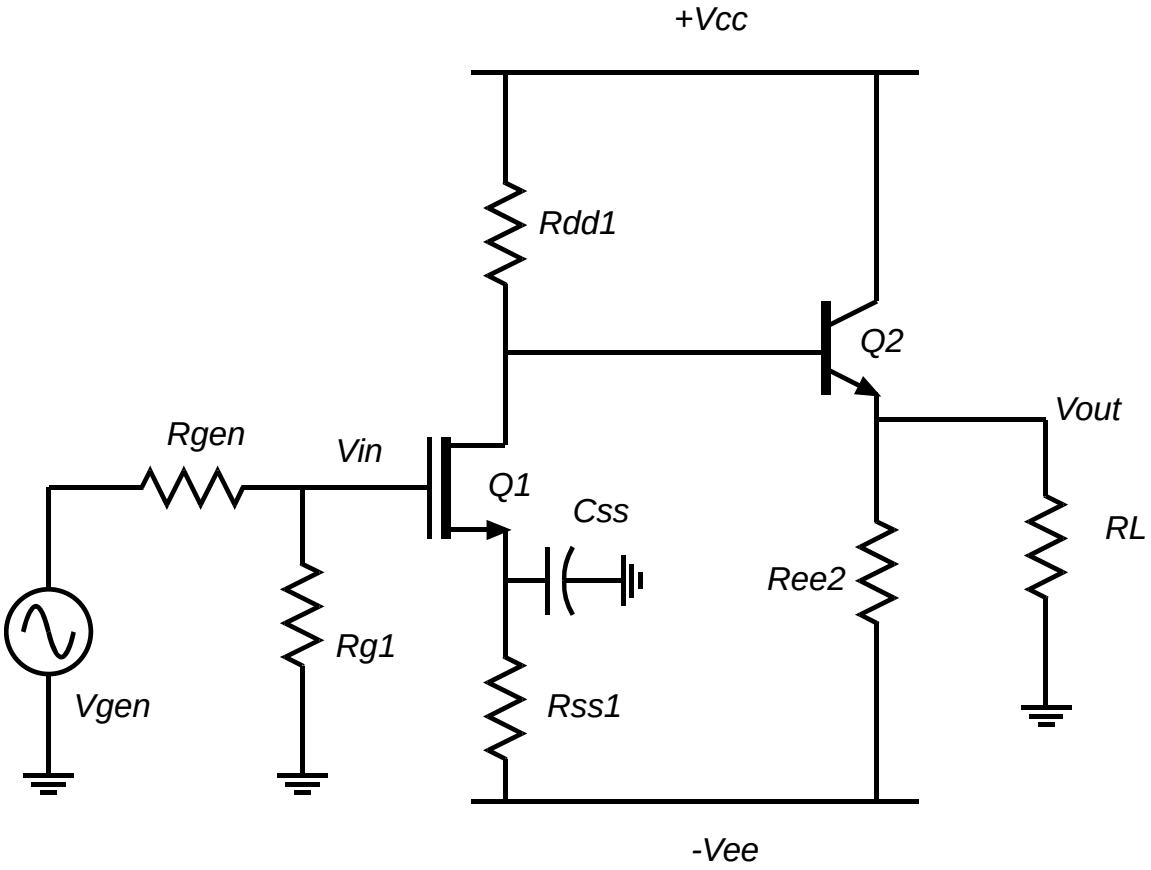
Part a, 10 points

DC bias.
Q1 is to be biased with 2 mA source current.
Q2 is to be biased with 10 mA collector current
The circuit is to be biased such that the DC emitter voltage of Q2 is zero volts.

Find: Rss1=_____ Rdd1=_____ Ree2=_____

Part b, 10 points

DC bias



On the circuit diagram above, label the DC voltages at **ALL nodes** and the DC currents through **ALL resistors**

Part b, 10 points

Find the small signal parameters of Q1 and Q2.

Transistor Q1: gm=_____ Ro=_____

Transistor Q2: re=_____ gm=_____ rπ =_____ Ro=_____

Part c, 20 points.

Find the small signal voltage gain (ve2/vb2) of Q2 and Q2's small-signal input resistance.

ve2/vb2=_____

Rin,q2= _____

Part d, 20 points

Find the small signal voltage gain (vd1/vg1) of Q1 and the *** amplifier *** input resistance.

vd1/vg1= _____

Rin,amplifier =_____

Part e, 10 points

Find (Vout/Vin), (Vin/Vgen) and (Vout/Vgen)

(Vout/Vin) = _____

(Vin/Vgen) = _____

(Vout/Vgen) = _____

Part f, 20 points

Find the maximum peak-peak output voltage (show all your work, specifically show the limits of the output swing arising from cutoff and saturation of Q1 and Q2)

COMMONSENSE POINT: NOTE THAT THE MAXIMUM SWINGS of Q1 must be multiplied by the voltage gain of Q2 in order to find their corresponding limit on output voltage.

Cutoff of Q1; Maximum ΔVout resulting = _____

Knee voltage of Q1; Maximum ΔVout resulting = _____

Cutoff of Q2; Maximum ΔVout resulting = _____

Saturation of Q2; Maximum ΔVout resulting = _____

Maximum Peak-Peak output =_____