ENEE 307, Final Quiz 2013

Part I (22 pts.): The following questions refer to Figure 1. You can neglect the effects of g_m and r_π where appropriate. $\beta = 200$.

1. Calculate the DC voltages at Vc1, Vc2, Ve1 and Ve2.
2. Calcuate the small signal voltage gains (A_v) if the output is taken from Vo1 and Vo2.
3. Show how you would replace the current source Iee with a current mirror to provide the DC bias current Iee. Include values of all components.

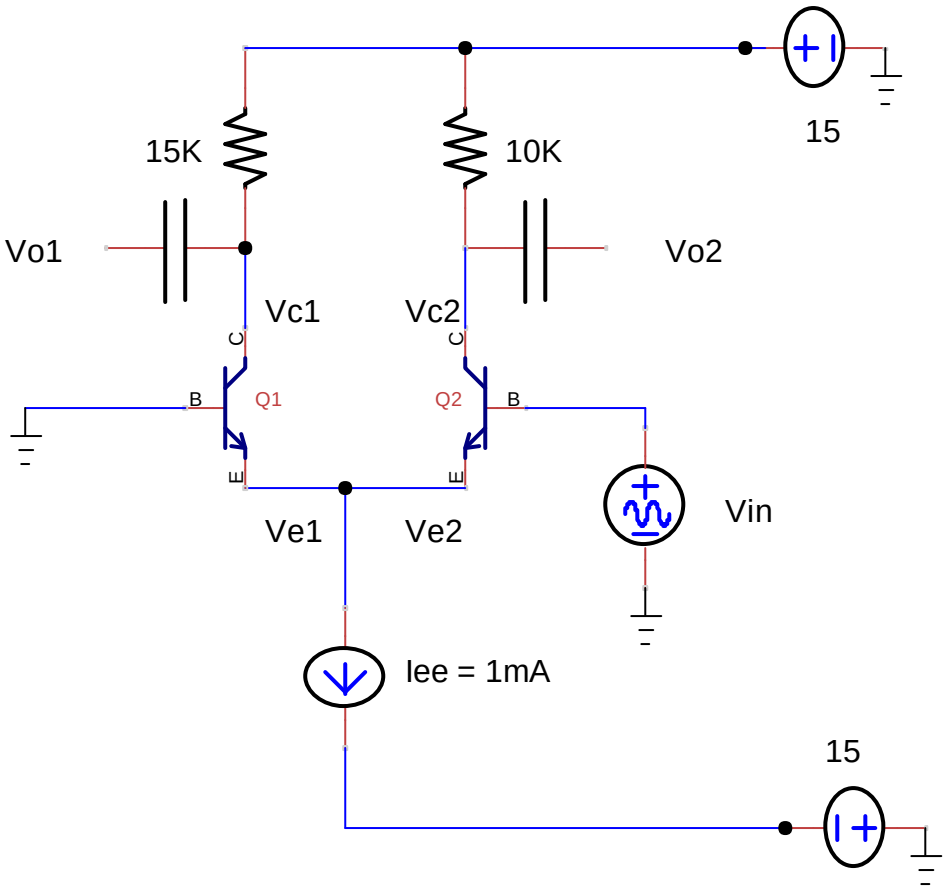


Figure 1

Part II (30 pts.): The following questions refer to the Common Source Amplifier in Figure 2. For the MOSFET in the figure K = $1.0x10^{-4}$ A/V^2, W=4um, L=2um, V_{TH} = 1.0V. Cgs=0.1pF, Cgd = 0.05pF, C1 = 0.1uF, C2 = 0.1uF.

1. Determine the DC bias voltages and currents: Id, Is, Ig, Vd, Vg and Vs.
2. Is the MOSFET is saturation, why?
3. Calculate the midband voltage gain.
4. Use the short circuit time constant approximation to find the low frequency pole of this circuit
5. Use Miller's theorem to find the high frequency pole of this circuit.
6. Sketch the voltage gain of this circuit as a function of frequency using a Bode plot. Indicate the poles found above, and give the slope of the lines in the sketch. Please label your plots carefully. (Y-axis: Voltage Gain in dB; X-axis: log of radial frequency (ω))

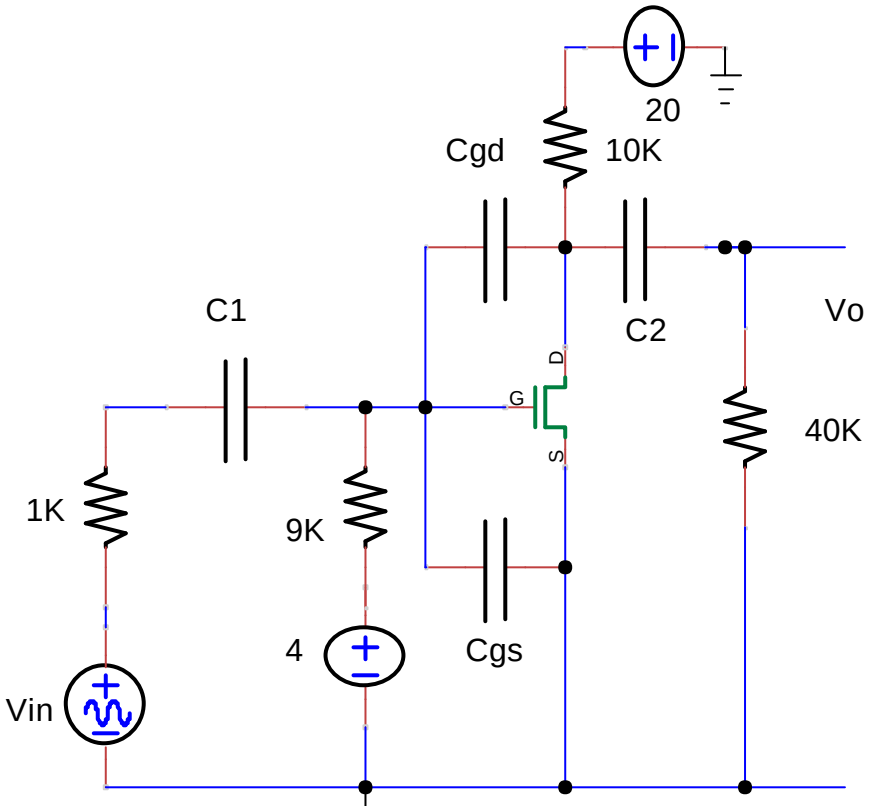


Figure 2

Part III (25 pts.): The following questions refer to the two stage amplifier in Figure 3.
$V_{in}(t) = 0.2\sin(2\pi \times 10^5 t)$, . $\beta = 200$

1. What is the DC value of the voltage at Ve2?
2. What is the voltage gain of this amplifier?
3. Sketch the signal at the output for two periods. Carefully label your graph indicating voltage and time.

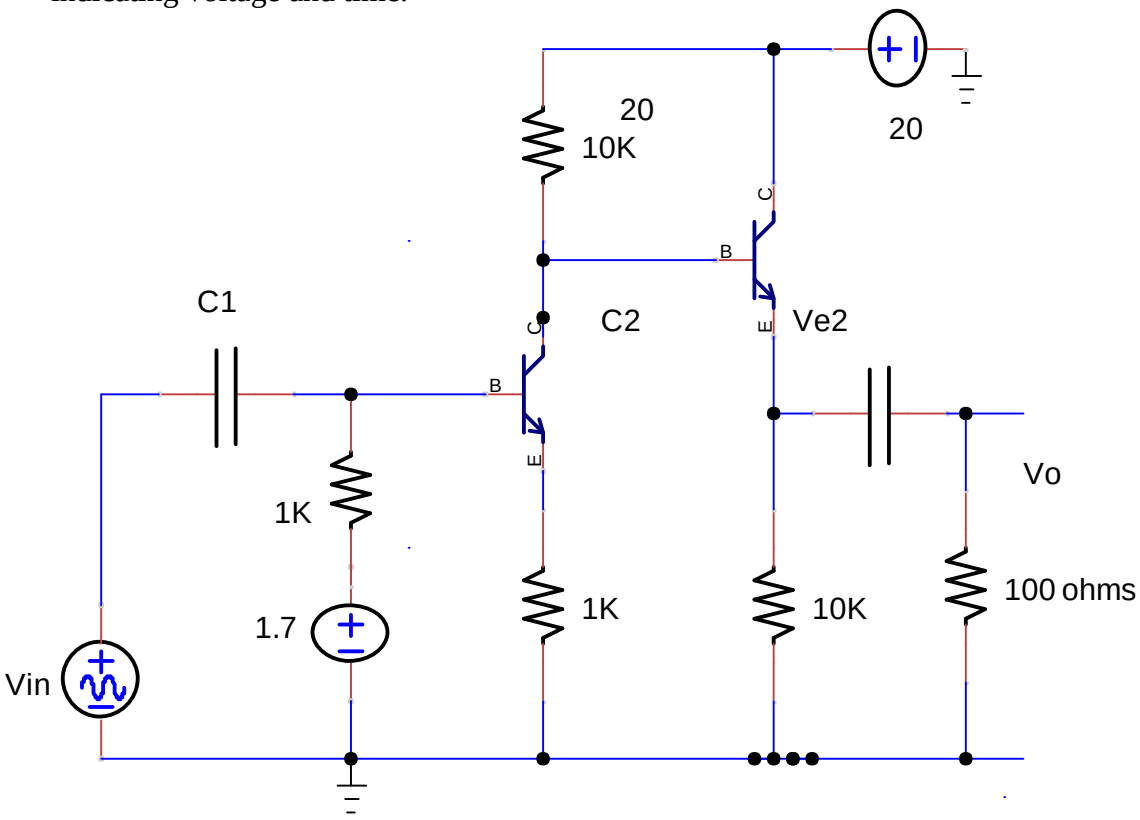


Figure 3

Part IV (23pts) : The following questions refer to the push pull amplifier in Figure 4. . β = 200. Neglect g_m when calculating resistances. Also, neglect the AC resistances of the diodes.

1. Calculate the DC voltage values at the points A, B, C, and D.
2. Calculate Rin and Rout.
3. An input signal of $V_{in}(t) = 5\sin(2\pi \times 10^5 t)$ with source resistance of 10K is connected at Vin, and a load resistor of 50Ω is connected at Vo (see whiteboard in front of room). Sketch Vo(t) for two periods; label your graphs indicating times and voltages.

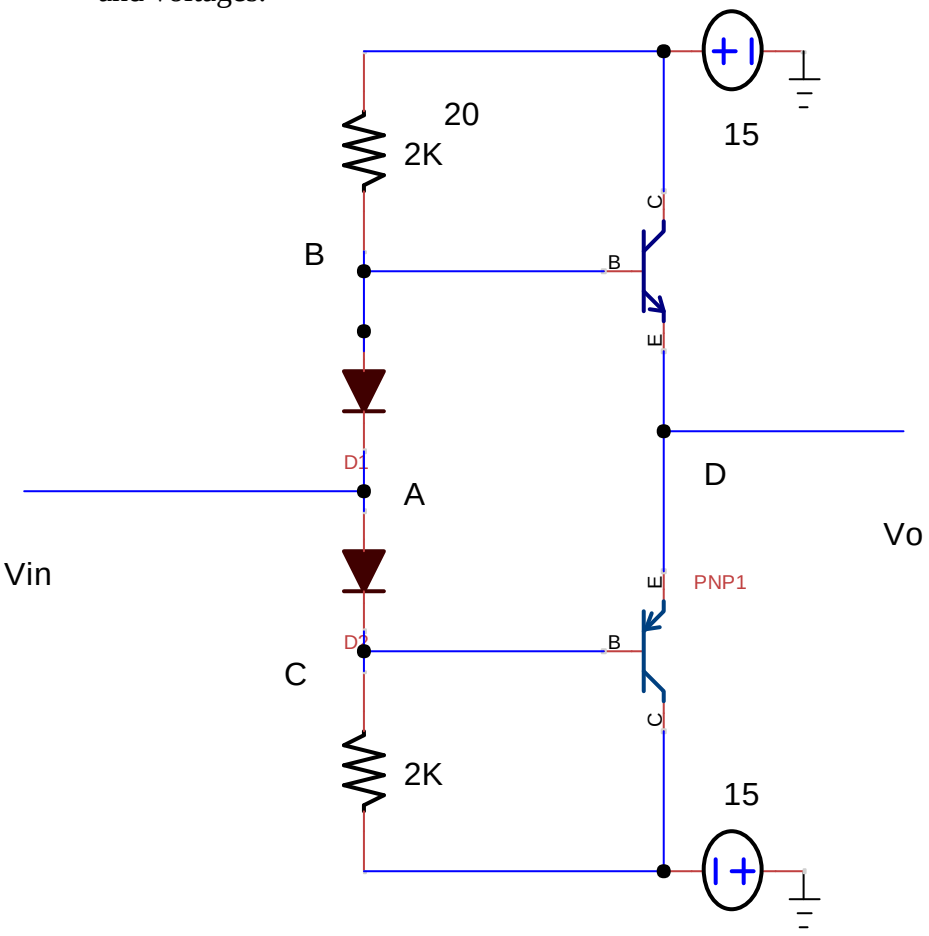


Figure 4

RTB= r_π + βRE Vt = 0.25V $P_L = -\Sigma 1/RiCi$

RTE = $1/g_m$ + RS/β RTC = infinity $P_{H-} = -1/\Sigma RiCi$

$Id = (KW/L)[(VGS-VTH)VDS - VDS^2/2]$

$Id = (KW/2L)(VGS-VTH)^2$