American University of Beirut
Faculty of Engineering and Architecture
Department of Electrical and Computer Engineering
EE 042 - Analog Electronics
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Quiz 1
Saturday November 14, 1998

Closed Book
Programmable Calculators Are Not Allowed.

Time: 1.5 hours

VERSION **A**

Name:_____ ID#:_____

- ❑ Provide your answer on the *computer card only*.
- ❑ Return the computer card attached to the question sheet.
- ❑ Use a pencil for marking your answers and ID number on the computer card.
- ❑ When using an eraser, make sure you erased well.
- ❑ On this sheet, write with a pen your name followed by your ID number.
- ❑ All questions are graded equally.

1. What is the version of your question sheet? (This question is not graded.)

   a) Version A
   b) Version B
   c) Version C
   d) Version D
   e) Version E

Assume in all problems that: V_{BE} = 0.7 V, V_T = 25 mV, and that all capacitors are large

All problems are equally graded

2. Calculate the input resistance R_i of the amplifier shown in Figure 1. For the BJTs, $\beta = 100$, V_A = 70V. Neglect base current during DC analysis.

a) 112.5 KΩ
b) 85.6 KΩ
c) 73.5 KΩ
d) 211.9 KΩ
e) 180 KΩ

3. Calculate the output resistance R_o of the amplifier shown in Figure 1. For the BJTs, $\beta = 100$, V_A = 70V. Neglect base current during DC analysis.

a) 18.7 KΩ
b) 20 KΩ
c) 100 KΩ
d) 16.67 KΩ
e) 39.2 KΩ

4. Calculate the voltage gain v_o/v_s for the amplifier shown in Figure 1. For the BJTs, $\beta = 100$. Neglect base current during DC analysis. Also, neglect r_o for the two transistors.

a) 623.4
b) 586.2
c) 478.7
d) 345.9
e) none of the above

5. In the circuit of Figure 2, what should be the values of R_E and R_L to get a voltage gain $v_o/v_s = -10$, and an input resistance R_i = 500 KΩ? Assume $\beta = 75$ and $r_e << R_E$.

a) R_E = 4.22 KΩ, R_L = 100 KΩ
b) R_E = 5.39 KΩ, R_L = 33.33 KΩ
c) R_E = 8.01 KΩ, R_L = 220.2 KΩ
d) R_E = 6.58 KΩ, R_L = 66.68 KΩ
e) R_E = 2.33 KΩ, R_L = 51.42 KΩ

6. In the circuit of Figure 3, find the voltage gain v_{o1}/v_s. Assume $\beta = 100$. Neglect base current in the DC analysis.

a) -0.984
b) -2.65
c) -18.3
d) 9.64
e) -322.5

7. In the circuit of Figure 3, find the voltage gain v_{o2}/v_s. Assume $\beta = 100$. Neglect base current in the DC analysis.

a) 1
b) 0.923
c) 0.867
d) 0.954
e) 0.994

8. A differential amplifier employing 10 KΩ collector resistors, and for which the emitter bias current source is 400 μA, uses BJTs for which β = 200. It is driven differentially by signal sources ($+v_d/2$ and $-v_d/2$) whose source resistances are 10 KΩ each. The emitter current source has an output resistance of 500 KΩ. For an output taken single-endedly, find the magnitude of the voltage gain v_o/v_d and the CMRR.

a) $|v_o/v_d| = 28.5$, CMRR = 69.1 dB
b) $|v_o/v_d| = 20.2$, CMRR = 78.2 dB
c) $|v_o/v_d| = 33.5$, CMRR = 82.3 dB
d) $|v_o/v_d| = 45.1$, CMRR = 45.6 dB
e) none of the above

9. Find the voltage gain v_o/v_d and the CMRR for the circuit of Problem 8 when two emitter resistors $R_E = 9\ r_e$ are added to the circuit.

a) $|v_o/v_d| = 13.4$, CMRR = 80.5 dB
b) $|v_o/v_d| = 3.83$, CMRR = 51.7 dB
c) $|v_o/v_d| = 12.6$, CMRR = 122.4 dB
d) $|v_o/v_d| = 6.63$, CMRR = 44.9 dB
e) none of the above

10. For the differential amplifier shown in Figure 4, find the magnitude of the differential gain v_o/v_d when $v_{B1} = +v_d/2$ and $v_{B2} = -v_d/2$.

a) 23.6
b) 82.5
c) 94.1
d) 17.4
e) 41.2

11. For the circuit shown in Figure 4, calculate the CMRR.

a) 67.2 dB
b) 82.9 dB
c) 75.6 dB
d) 56.9 dB
e) 49.1 dB

12. When the inputs to a differential amplifier are sin(t) - cos(t) mV and sin(t) + cos(t) mV, the output is 20000 cos(t) - sin(t) mV. Find the CMRR.

a) 20 dB
b) 40 dB
c) 80 dB
d) 100 dB
e) 60 dB

13. A source follower amplifier uses MOSFETs for which $V_t = 1$V, V_A is very large and body effect is negligible. If the MOSFET is biased at $I_D = 1$ mA, $V_{GS} = 2$V, what is the range of load resistances for which the voltage gain of the follower is greater than 0.9?

a) > 500 Ω
b) > 4500 Ω
c) < 4500 Ω
d) < 450 Ω
e) > 450 Ω

14. The common source amplifier shown in Figure 5 uses MOSFETs for which $k'(W/L) = 20\ \mu A/V^2$ and $V_A = 100$ V. How does the voltage gain v_o/v_s change when I_{REF} is reduced from 100 μA to 1 μA?

a) The magnitude of the gain decreases from 316.2 to 31.6
b) The magnitude of the gain decreases from 632 to 63.2
c) The magnitude of the gain increases from 63.2 to 632
d) The magnitude of the gain increases from 31.6 to 316.2
e) There is not enough data to solve this problem.

15. Which of the following statements is true?
I. The voltage gain of an emitter-follower is much larger than 1
II. The input resistance of a common-base is very small
III. The output resistance of a common-drain is very large
IV. The current gain of common-emitter is always close to 1

a) only I is true
b) only II is true
c) only III is true
d) only IV is true
e) all are false

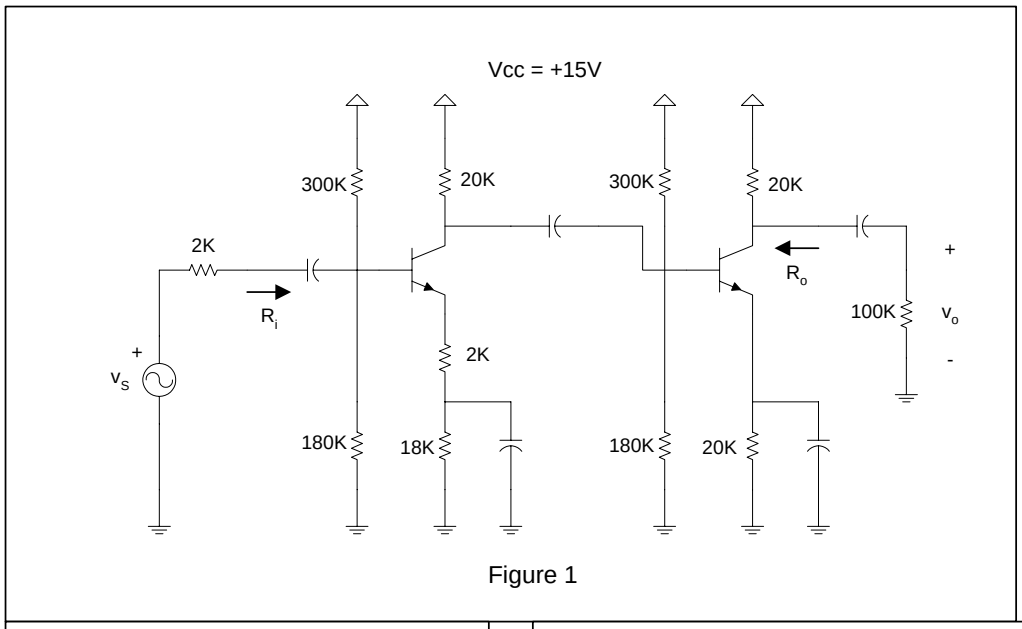

Figure 1

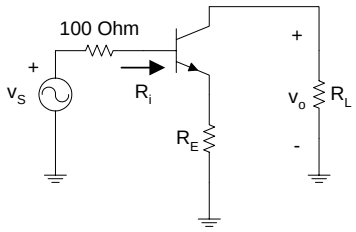

Figure 2

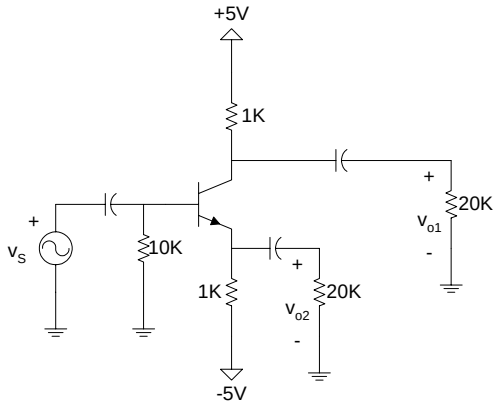

Figure 3

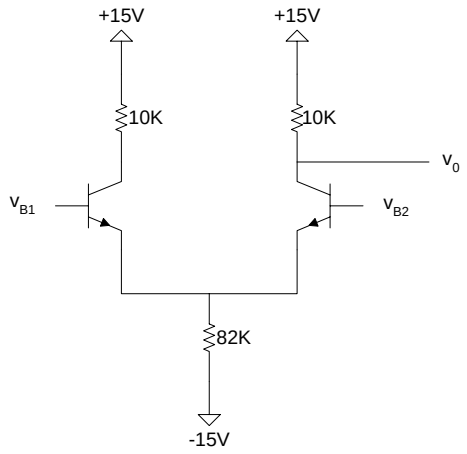

Figure 4

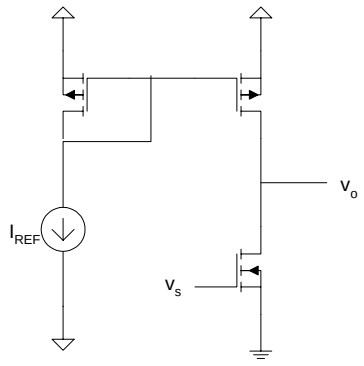

Figure 5