exam1

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Part I

Instructions

Due Friday February 20 at 5pm to Prof. White or under his office door.

- Neatly write your answers. Clearly label the question you are answering.
- Show your relevant intermediate work and draw a box around your final answer.
- Use a single column of work (no prizes for fitting everything squeezed onto one page).
- Number your pages.
- Engineering paper is preferred.

Use a cover sheet containing "ECE 341 Exam 1", your name and honor code.

You may not use:

- Wolfram Alpha
- any other web-based computer algebra system
- any online reference website such as Wikipedia

You may use:

- Jaeger textbook
- LTspice
- Matlab, Maple, Python, or other software package available on College of Engineering lab computers
- Any materials posted to either the course's Blackboard site or the auxilliary site http://whiteaudio.com/valpo/341

Part II

Problems

1 Op-amp circuit analysis

1.1 Provide the formulas for the differential and common-mode voltages (V_d, V_{cm}) when given the individual node voltages (V_1, V_2).

1.2 Provide the formulas for the two node voltages (V_1, V_2) when given the differential and common-mode voltages (V_d, V_{cm}).

1.3 For Figure 1, find the input impedance of the circuit r_{in}.

1.4 For Figure 2, find the differential gain $v_o/(v_{I1} - v_{I2})$.

1.5 For Figure 2, find the common-mode gain v_O/v_{Icm}. How should the resistors be chosen to yield a common-mode gain of zero?

1.6 For Figure 3, explain why the voltage sources are incorrectly labeled.

2 Op-amp non-ideal characteristics

2.1 For each of the six listed terms:

$A_0, V_{os}, I_B, I_{OS}, CMRR, PSRR$

- Define and describe the parameter. Also, draw a circuit or give an example showing how this non-ideal op-amp parameter may be included in a circuit using such an op-amp.

2.2 An opamp has a gain-bandwidth product of $5\,\mathrm{MHz}$. What would be the a non-inverting amplifier's maximum $-3\,\mathrm{dB}$ frequency if configured for a DC gain of $1000\,\mathrm{V/V}$?

2.3 What minimum GBW must an opamp have to be suitable for amplifying audio signals of up to $20\,\mathrm{kHz}$ with a minimum gain of $40\,\mathrm{dB}$?

2.4 Use the following parameters:

$$A(s) = \frac{10^5}{\left(1 + \frac{s}{2}\right)\left(1 + \frac{s}{200}\right)}$$

$$\beta(s) = \frac{1}{\left(1 + \frac{s}{400}\right)}$$

2.5 What is the transfer function of an amplifier constructed using the above forward gain and feedback factor?

2.6 What is the DC gain of this amplifier?