Electronics Homework Set #2

Problem 1.29

A certain power amplifier supplies a 20 V peak 100 Hz sine wave to an 8- Ω load resistance as illustrated in the figure below. The currents supplied by the power supplies are half-sinusoid pulses, as shown in the figure. Find the average current for each supply, the average power supplied by each source, and the efficiency of the amplifier.

![Amplifier circuit diagram]

Problem 1.31

An amplifier has an input voltage of 10 mV rms and an output voltage of 5 V across a 10- Ω load. The input current is 1 µA rms. Assume that the input and output impedances are purely resistive. Find the input resistance. Find the voltage gain, the current gain, and the power gain as ratios and in decibels.
**Problem 1.37**

An amplifier has an input resistance of 20 Ω, an output resistance of 10 Ω, and a short-circuit current gain of 3000. The signal source has an internal voltage of 100 mV rms and an internal impedance of 200 Ω. The amplifier load is a 5 Ω resistance. Find the current gain, voltage gain and power gain of the amplifier. If the power supply has a voltage of 12 V and supplies an average current of 2 A, find the power dissipated in the amplifier.

**Problem D1.49**

Block Diagram Level Amplifier Design. An amplifier is needed for the documentation of voltages in the Earth created by a Navy extremely low frequency (ELF) antenna in northern Michigan (used for communication with submarines). Voltage waveforms occurring between probes to be placed in the earth are to be amplified before being applied to the analog-to-digital converter (ADC) inputs of small computers. The internal impedance of the probe can be as high as 10 kΩ in dry sand or as low as 10 Ω in muck. Because several different models of ADC’s are to be used in the project, the load impedance for the amplifier varies from 10 kW to 1 MW. Nominally the voltage applied to the ADC should be 10 times the voltage applied to the probe ±3%. What type of ideal amplifier is best suited for this application? Use your best judgment, and state what are the specifications for the impedances and gain parameter of the amplifier.

1. Consider whether zero or infinite input resistance would be best for sensing the open-circuit voltage of the probes.
2. Consider whether zero or infinite output resistance would be best for making the output voltage independent of the input resistance of the ADC.
3. Based on these selections of input and output resistances, use Table 1.1 on page 39 to select the amplifier type.

<table>
<thead>
<tr>
<th>Table 1.1. Characteristics of ideal amplifiers.</th>
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<tbody>
<tr>
<td>Amplifier Type</td>
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<tr>
<td>Voltage</td>
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<td>Current</td>
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<td>Transconductance</td>
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<td>Transresistance</td>
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**Problem 1.52**

Sketch the gain magnitude of a typical dc-coupled amplifier against frequency. Repeat for an ac-coupled amplifier.
Problem 1.55

The input voltage to a certain amplifier is
\[ v_i(t) = 0.1 \cos(2000\pi t + 30^\circ) \]
and the output voltage is
\[ v_o(t) = 10 \sin(2000\pi t + 15^\circ) \]
Find the complex voltage gain of the amplifier at \( f = 1 \text{ kHz} \) and express the magnitude of the gain in decibels.

Problem 1.61

The input signals \( v_{i1} \) and \( v_{i2} \) illustrated in the figure below are the inputs to a differential amplifier with a gain of \( A_d = 10 \). (Assume that the common-mode gain is zero.) Sketch the output of the amplifier to scale versus time. Sketch the common-mode input signal to scale against time.