1) This two-part problem deals with aspects of electric power, precision, uncertainty, and significant digits.

   a) The measured DC current into a resistor is 10 milliamps (±1%) and the dissipated power is known to be 100 milliwatts (±5%). Find the value of the resistor and its ± uncertainty, both expressed in Ohms.

   b) The AC voltage to a load is 100 V\(_{\text{rms}}\) (±3%), the current is 1 A\(_{\text{rms}}\) (±3%), and the phase angle by which the current lags the voltage is 30º (±10º). What are the average power consumed in Watts and the ±% uncertainty of this value?

2) What is the nominal value of shunt capacitance (in Farads) needed to minimize the net current for the load specified in Problem #1, part (b)? What is this minimized current (in A\(_{\text{rms}}\))? Assume 60 Hz for frequency. *You do not need to determine the uncertainties of these answers.*

3) Consider the network of real diodes and resistors shown below.

   ![Diode Network Diagram]

   a) Accounting in a simple way for the finite forward bias voltage needed to turn on the diodes, carefully sketch the v-i characteristic of the network. Explain how you got your answer.

   b) Carefully plot current \(i(t)\) versus time \(t\) for an AC voltage of \(v(t) = 2 \cos(2\pi\cdot10^3)\) applied to this network. For reference, superimpose the voltage waveform.
4) Consider the RC and RL circuits shown in (A) and (B) below.

(a) Find an expression for the impedance $Z_{RC}$ of circuit A.
(b) Find approximate low- and high-frequency limiting expressions for $Z_{RC}$. Explain how you arrived at these two limits.
(c) Find an expression for the admittance $Y_{RL}$ of circuit B.
(d) Find approximate low- and high-frequency limiting expressions for $Y_{RL}$. Explain how you arrived at these two limits.
(e) Obtain expressions for the critical frequencies that divide low from high frequency behavior for A and for B.