Section 3.6: Practical Inductors

P3.68. A 10-mH inductor has a parasitic series resistance of $R_s = 1\ \Omega$, as shown in Figure P3.68. **a.** The current is given by $i(t) = 0.1\cos(10^5 t)$. Find $v_R(t)$, $v_L(t)$, and $v(t)$. In this case, for 1-percent accuracy in computing $v(t)$, could the resistance be neglected? **b.** Repeat if $i(t) = 0.1\cos(10t)$.

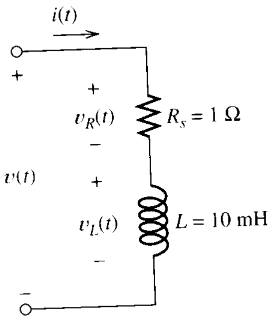

Figure P3.68

P3.69. Draw the equivalent circuit for a real inductor, including three parasitic effects.

P3.70. Suppose that the equivalent circuit shown in Figure 3.22 accurately represents a real inductor. A constant current of 100 mA flows through the inductor, and the voltage across its external terminals is 500 mV. Which of the circuit parameters can be deduced from this information and what is its value?

P3.71. Consider the circuit shown in Figure P3.71, in which $v_C(t) = 10\sin(1000t)$ V, with the argument of the sine function in radians. Find $i(t)$, $v_L(t)$, $v(t)$, the energy stored in the capacitance, the energy stored in the inductance, and the t tal stored energy. Show that the total stor energy is constant with time. Comment on t results.

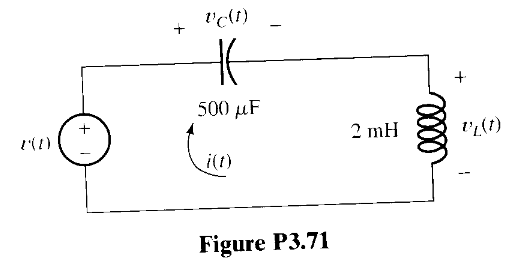

Figure P3.71

P3.72. The circuit shown in Figure P3.72 has $i_L(t)$ $0.1\cos(5000t)$ A in which the argument of t cos function is in radians. Find $v(t)$, $i_C(t)$, i(the energy stored in the capacitance, the ener stored in the inductance, and the total stor energy. Show that the total stored energy constant with time. Comment on the results.

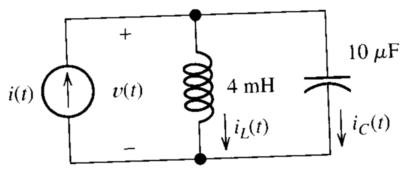

Figure P3.72

Section 3.7: Mutual Inductance

P3.73. Describe briefly the physical basis for mut inductance.

P3.74. The mutually coupled inductances in Fig P3.74 have $L_1 = 1$ H, $L_2 = 2$ H, a $M = 1$ H. Furthermore, $i_1(t) = \sin(10t)$ a $i_2(t) = 0.5\sin(10t)$. Find expressions for v_1 and $v_2(t)$. The arguments of the sine functio are in radians.

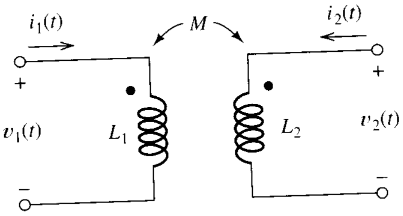

Figure P3.74

***P3.75.** Repeat Problem P3.74 with the dot place the bottom of L_2.

***P3.76.** **a.** Derive an expression for the equivalent ductance for the circuit shown in Figure P3. **b.** Repeat if the dot for L_2 is moved to bottom end.

amplifiers may be ac coupled, in which case the gain falls off at low frequencies, reaching zero gain at dc. Gain magnitude falls to zero at sufficiently high frequencies for all amplifiers.

10. Linear distortion can be either amplitude distortion or phase distortion. Amplitude distortion occurs if the gain magnitude is different for various components of the input signal. Phase distortion occurs if amplifier phase shift is not proportional to frequency.

11. Amplifier pulse response is characterized by rise time, overshoot, ringing, and tilt.

12. Nonlinear distortion occurs if the transfer characteristic of an amplifier is not straight. Assuming a sinusoidal input signal, nonlinear distortion causes harmonics to appear in the output. The total harmonic distortion rating of an amplifier indicates the degree of nonlinear distortion.

13. A differential amplifier ideally responds only to the difference between its two input signals (i.e., the differential input signal).

14. The common-mode input is the average of the two inputs to a differential amplifier. Common-mode rejection ratio (CMRR) is the ratio of the differential gain to the common-mode gain. CMRR is an important specification for many instrumentation applications.

15. Dc offset is the addition of a dc term to the signal being amplified. It is the result of bias current, offset current, and offset voltage, and it can be canceled by use of a properly designed balance circuit.

Problems

Section 11.1: Basic Amplifier Concepts

P11.1. Explain how an inverting amplifier differs from a noninverting amplifier.

P11.2. Draw the voltage-amplifier model and label its elements.

P11.3. What are two causes of "loading effects" in an amplifier circuit?

***P11.4.** A signal source with an open-circuit voltage of $V_s = 2$ mV rms and an internal resistance of 50 kΩ is connected to the input terminals of an amplifier having an open-circuit voltage gain of 100, an input resistance of 100 kΩ, and an output resistance of 4 Ω. A 4-Ω load is connected to the output terminals. Find the voltage gains $A_{vs} = V_o/V_s$ and $A_v = V_o/V_i$. Also, find the power gain and current gain.

***P11.5.** A certain amplifier operating with a 100-Ω load has a voltage gain of 50 and a power gain of 5000. Determine the current gain and input resistance of the amplifier.

P11.6. The current gain of an amplifier is 500, the load resistance is 100 Ω, and the input resistance of the amplifier is 1 MΩ. Determine the voltage gain and power gain under these conditions.

P11.7. An amplifier having $R_i = 1$ MΩ, $R_o = 1$ kΩ and $A_{voc} = -10^4$ is operated with a 1-kΩ load. A source having a Thévenin resistance of 2 MΩ and an open-circuit voltage of $3\cos(200\pi t)$ mV is connected to the input terminals. Determine the output voltage as a function of time and the power gain.

P11.8. A certain amplifier has an open-circuit voltage gain of unity, an input resistance of 1 MΩ and an output resistance of 100 Ω. The signal source has an internal voltage of 5 V rms and an internal resistance of 100 kΩ. The load resistance is 50 Ω. If the signal source is connected to the amplifier input terminals and the load is connected to the output terminals, find the voltage across the load and the power delivered to the load. Next, consider connecting the load directly across the signal source without the amplifier, and again find the load voltage and power. Compare the results. What do you co... gain an... load?

P11.9. An am... and A_v... A sour... and a s... is conn... the out... the pow...

P11.10. An ide... input te... fier out... resistan... source ... the outp... input re...

P11.11. An amp... of 100. ... voltage ... output ...

P11.12. Suppose... from 5 ... an amp... the load... variatio... rameter... situation... the para...

P11.13. A certa... load. Th... are equa... resistan...

P11.14. An amp... of 1000, ... output r... an inter... to the i... 8-Ω load... Find the... V_o/V_i. A... gain.

P11.15. The outp... P11.15 is...

* Denotes that answers can be found on the OrCAD CD and on the website www.myengineeringlab.com