King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE205: Electric Circuits II
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HW 6: Mutual Inductance and Transformers

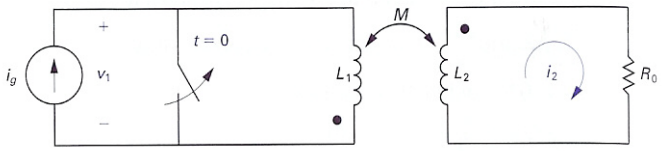
Problem 1:

There is no energy stored, in the circuit below, at the time the switch is opened.

a) Derive the differential equation that governs the behavior of i_2 if L_1=2 H , L_2 =8 H , M=1 H, and R_o=16 Ω. **(4 points)**

b) Show that when $i_g = 8e^{-t} - 8\ A, \quad t \geq 0.$, the differential equation derived in (a) is satisfied when $i_2 = e^{-t} - e^{-2t}\ A, \quad t \geq 0.$ **(4 points)**

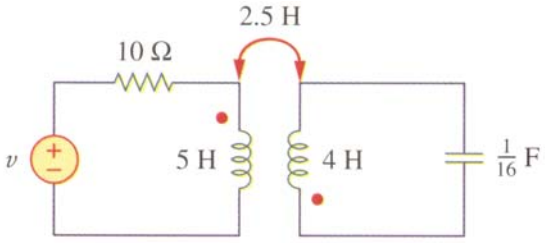
c) What is the coupling coefficient for the two inductors? **(2 points)**



Problem 2:

A load which consists of 150 Ohms resistor in series with a 20 nF capacitor is connected to a sinusoidal voltage source by a linear transformer. The source is operating at a frequency of 500 *k* rad/s. At this frequency the internal impedance of the source is 5 + *j*16 Ohms. The rms voltage at the terminals of the source is 125 V when it is not loaded. The parameters of the linear transformer are R_1= 12 Ohms, L_1= 160 micro H, R_2= 50 Ohms, L_2= 250 micro H, and M=150 micro H.

What is the current in the primary side of the transforme



Problem 3:

Consider the circuit in the figure.

a. Determine the coupling coefficient.

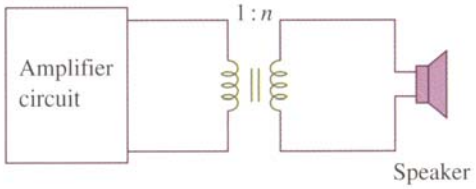
b. Assume that the physical structure of these coupled coils is such that $P_1 = P_2$, (permeance1 = permeance2). What is the turns ratio N_2 / N_1, if N_1 is the number of turns on the 5H coil?

c. Calculate the energy stored in the coupled inductors at time t=1s if $v = 60\cos(4t + 30^o)$

Problem 4:

An ideal transformer is used to match the amplifier circuit to the loudspeaker to achieve maximum power transfer. The Thevinin (or output) impedance of the amplifier is 192 Ohms, and the internal impedance of the speaker is 12 Ohms.

a) Determine the required turns ratio *n*.



b) What is the ratio of power improvement (*i.e* Power with ideal matching transformer / power when directly connected without transformer) ?

Good Luck, **Dr. Ali Muqaibel**