EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE - 2010/2011

SECOND SEMESTER

(June 2013)

PH 104 AC THEORY

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Time: 01 hour.

Answer ALL Questions

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1. A pure resistor and an inductor are connected in series to a battery of e.m.f. E as shown in figure 1.

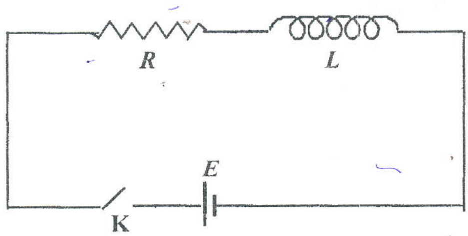

Figure 1

When the key K is closed, the current I start to increase. If the inductor (L) was not present, the current would rise rapidly to a maximum steady value $I_0 = \frac{E}{R}$. According to Faraday's and Lenz's law a self-induced electromotive force $L\frac{dI}{dt}$ appears due to the inductance L which opposes the rise of the current. Show that immediately after key K is closed, the current in the circuit at time (t) is given by $I = I_0\left[1-\exp\left(-\frac{R}{L}t\right)\right]$.

A relay, having an inductance 5.0 H and resistance 200 Ω operates with a current 1.5 mA. When the relay is switched to a dc voltage of 0.5 V,
(a) how long will the relay take to operate?
(b) what will be the rate of increase of current at the instant of operation?

2. If a sinusoidal alternating voltage signal having amplitude V_0 and angular frequency ω is represented by $V = V_0\exp(j\omega t)$, then find the *complex impedance* of a pure resistor, capacitor and inductor when they are individually connected to the voltage $V = V_0\exp(j\omega t)$.

A series LCR circuit is connected to an alternating voltage as shown in figure 2. Find expressions for the current through the circuit and the voltage across the inductor.

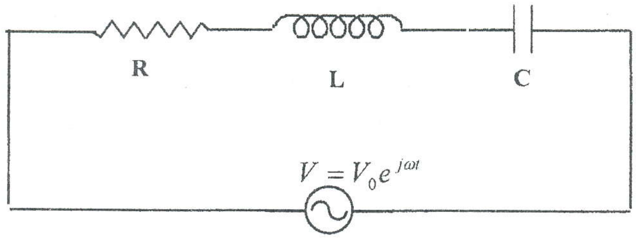

Figure 2

A coil having inductance of 460 mH and resistance of 48 Ω is connected in series with a capacitor having capacitance 9 μF and a r.m.s. voltage of 120 V is supplied to the circuit. What should be the frequency of the supplied voltage to obtain maximum current in the circuit? What is the voltage across the inductor under these conditions?