11. (a) State the Kichhoff Rules for electrical networks, and state the basis for these rules in terms of fundamental conservation laws. [4]

(b) Apply Kirchhoff's Rules to find the effective impedance z_{eff} of two impedances z_1 and z_2 in series. [2]

(c) The differential equation for charge in an LCR series circuit

$$L\frac{d^2Q}{dt^2} + R\frac{dQ}{dt} + \frac{Q}{C} = 0$$

is solved by

$$Q = Q_0\{\exp(-\alpha + i\omega)t\}$$

Prove that the constants α and ω are given by

$$\alpha = \frac{R}{2L}, \quad \omega^2 = \frac{1}{LC} - \frac{R^2}{4L^2}$$ [6]

(d) Given that the peak driving voltage in the circuit shown in Figure 6 is 110 V and the frequency of oscillation is 60 Hz, calculate the maximum current and the maximum potential drop across the inductor. [4]

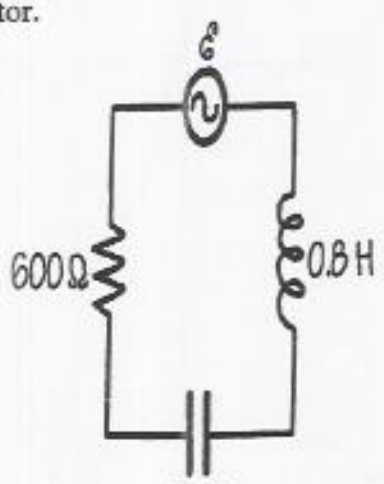

Figure 6

(c) Find the voltages across the inductor in the AC circuit of Figure 6 at times $t = 0$ and $t = 0.001$ s if the applied *e.m.f.* is given by $V = V_0\sin\omega t$. [4]

END OF PAPER