Answers Week 10

10-1 Mechanical System: (i) Pull mass to A, store potential energy $\frac{1}{2}kA^2$. (ii) Release mass, it will reduce its potential energy until x = 0, when all the energy is kinetic. (iii) It will use its kinetic energy to go to x = -A where Energy is again all potential. Hence oscillation occurs with x = $A\,Cos\,\omega t$, $\omega = \sqrt{\frac{k}{M}}$

Electrical System: (i) Charge capacitor, store energy $\frac{Q^2}{2C}$ in $\underrightarrow{E}$ - field. (ii) Open S_1, close S_2. Capacitor sets up current in L, $\underrightarrow{E}$ - field in C collapses all the energy is in the $\underrightarrow{B}$ field in L. (iii) Current through L recharges C until $\underrightarrow{B} \rightarrow 0$. Hence, charge oscillation occurs

$$q = Q\,Cos\,\omega t, \quad \omega = \frac{1}{\sqrt{LC}}$$

10-3 (i) If current increases by a factor of 2, X is a capacitor because $i_c = \varepsilon_m W C\,Cos\,\omega t$

(ii) If current reduces by a factor of 2, X is an inductor because $i_c = -\frac{\varepsilon_m}{W L} Cos\,\omega t$.

10-5 (155 – 163) V

10-7 $C = 5.31 \times 10^{-8}$ F

10-9 Power $P_w(t) = i(t)\,\varepsilon(t)$

$$= i_m\,\varepsilon_m \left[Sin^2\omega t\,Cos\phi + Sin\,\omega t\,Cos\,\omega t\,Sin\phi\right]$$

$$\langle P_w \rangle = \frac{i_m\,\varepsilon_m}{2} Cos\phi = \frac{\varepsilon_m^{\,2}}{2Z} Cos\phi = \frac{\varepsilon_m^{\,2}}{2R} Cos^2\phi$$

Because $Cos\phi = \frac{R}{Z}$

10-11 Conduction Current: FLUX OF CHARGE IN A CONDUCTOR $I_C = n_e\,e\,A V_D$. Displacement Current: RATE OF CHANGE OF FLUX OF E as a function of time $i_D = \varepsilon_o \frac{\Delta\phi_E}{\Delta t}$.