B-I (H) Paper II

Dr. Supriya Kumari
Deptt. of Physics
J.N.C, Madhubani

Energy stored in a magnetic field:

The inductance of a circuit resists any change in current through it and therefore any change in magnetic flux linked with it. Hence work has to done in increasing the current from zero to a particular value say I against the e.m.f. induced in the inductance i.e. energy is required to build up a current in an inductor.

If e is the self-induced e.m.f at any instant in the circuit when the current established in the circuit is i and it changes at the rate $\frac{di}{dt}$, then

$$e = -L\frac{di}{dt}$$

where L is the co-efficient of self-inductance. If the current i remains unchanged for a small time dt, then

$$\text{Work done in time } dt = -e\frac{di}{dt}$$

i. Total work done in time W in establishing a current I in a time t or total energy required is given by

$$W = \int_0^t -ei\,dt = \int_0^t L\frac{di}{dt}\cdot i\,dt$$

$$= \int_0^t L\cdot i\,di = \left[\frac{1}{2}Li^2\right]_0^I$$

$$= \frac{1}{2}LI^2 \quad \text{—(1)}$$

This workdone is equivalent to energy which is stored in a magnetic field.

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