

8.1 INTRODUCTION

Now gradually we are proceeding towards the application of electromagnetism which we have studied earlier. Before starting this section let's first start what we mean by induction? In layman language; induction means introducing something new in an existing system e.g., induction of new teachers or students in a school.

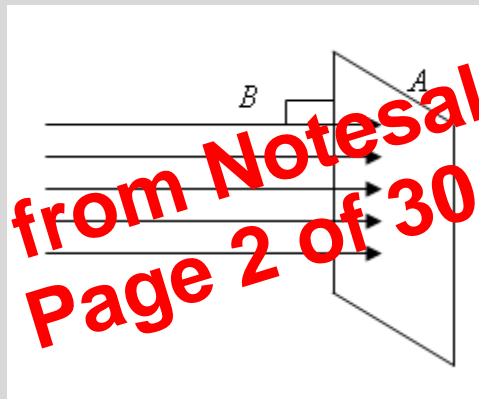
In the same way if we introduce E.M.F, current or magnetic properties, it will be known as induced E.M.F, induced current or induced magnetism respectively. We have a very good concept of magnetic field and its strength B which can be produced either by means of a permanent magnet or using an electromagnet.

Electromagnetic induction is the most common area of physics with which people normally deal with; for example generators, transformers, electric bells, relays, loudspeakers are their common examples. The era of electromechanical saw a boom when electromagnetism along with electromagnetic induction boosted.

8.2 MAGNETIC FLUX

It is number of field lines passing through a certain perpendicular area.

By definition “the product of magnetic flux density and perpendicular area is called magnetic flux”.



Mathematically $\phi = B \times A$

The unit of magnetic flux is Weber. So $1W = 1T \times m^2$

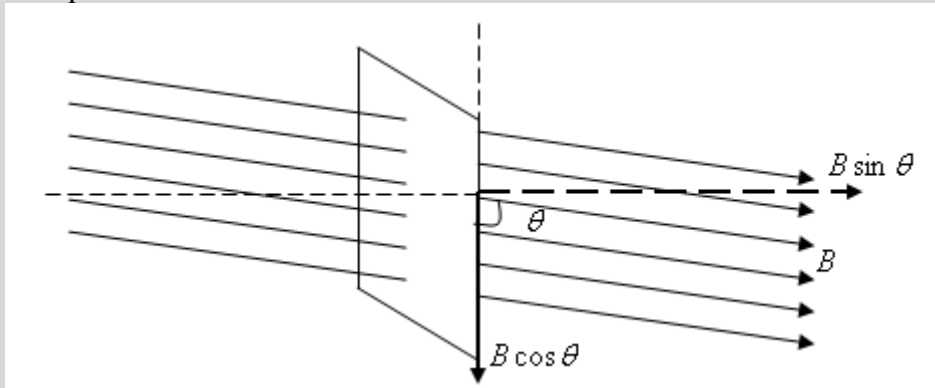
WEBER:

If a magnetic flux density of $1T$ passes normally an area of $1m^2$ then magnetic flux is said to be of 1 Weber.

Suppose if magnetic flux density B makes an angle θ either with the plane of area A or with the normal of the plane then situation can be expressed in two ways.

CASE # 1:

“ θ ”with the plane



So $B \sin \theta$ is the perpendicular component to area A . Hence

$$\phi = (B \sin \theta) \times A$$

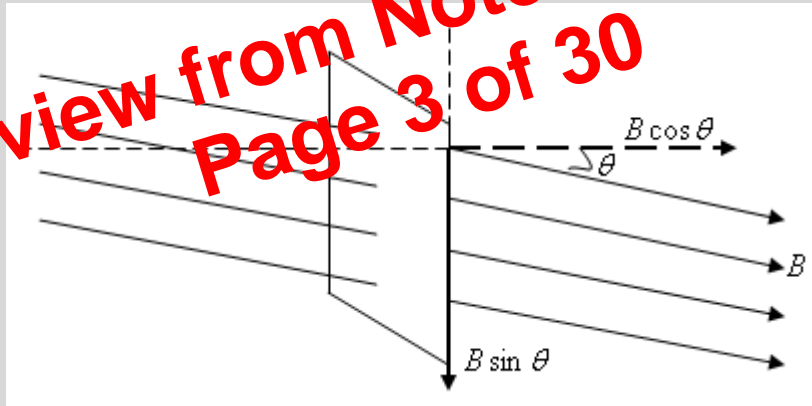
$$\phi = AB \sin \theta$$

If $\theta = 0^\circ$, $\sin 0^\circ = 0$ and $\phi = 0$

If $\theta = 90^\circ$, $\sin 90^\circ = 1$ and $\phi_{\max} = B \times A$

CASE # 2:

“ θ ”with the normal



In this case $B \cos \theta$ is perpendicular to the area A . Therefore

$$\phi = (B \cos \theta)A$$

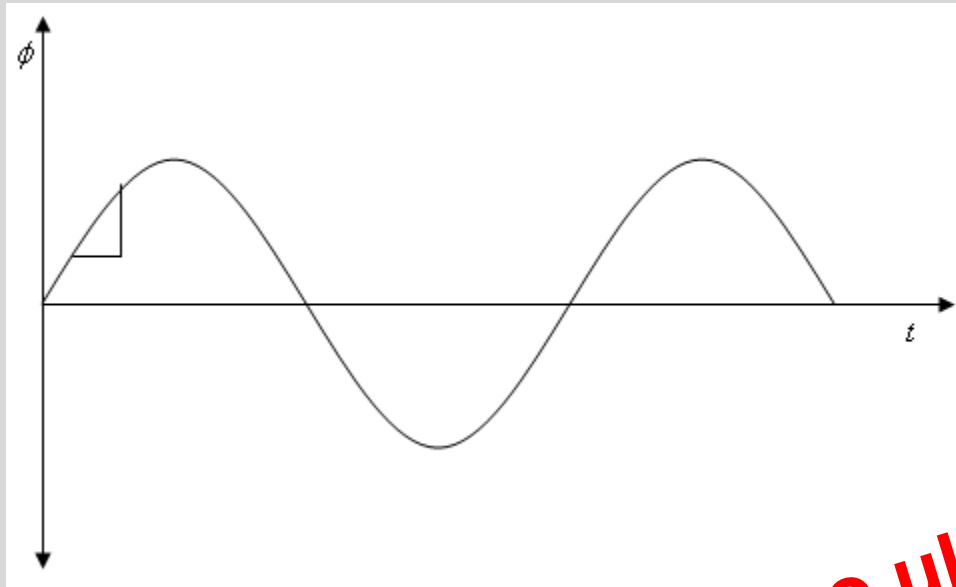
$$\phi = BA \cos \theta$$

So if $\theta = 0^\circ$, $\cos 0^\circ = 1$ and $\phi_{\max} = B \times A$

Similarly if $\theta = 90^\circ$, $\cos 90^\circ = 0$ and $\phi_{\min} = 0$

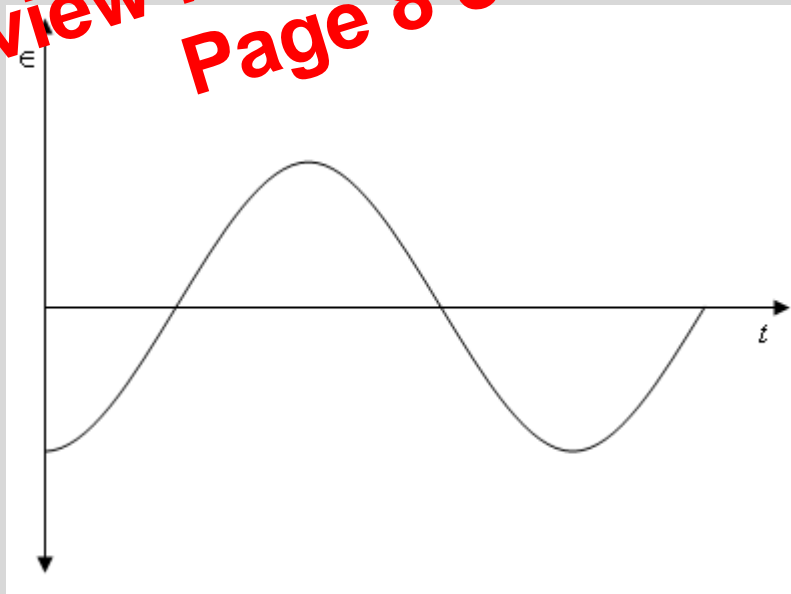
So $-\frac{d\phi}{dt} \propto -\frac{dI}{dt}$

Therefore

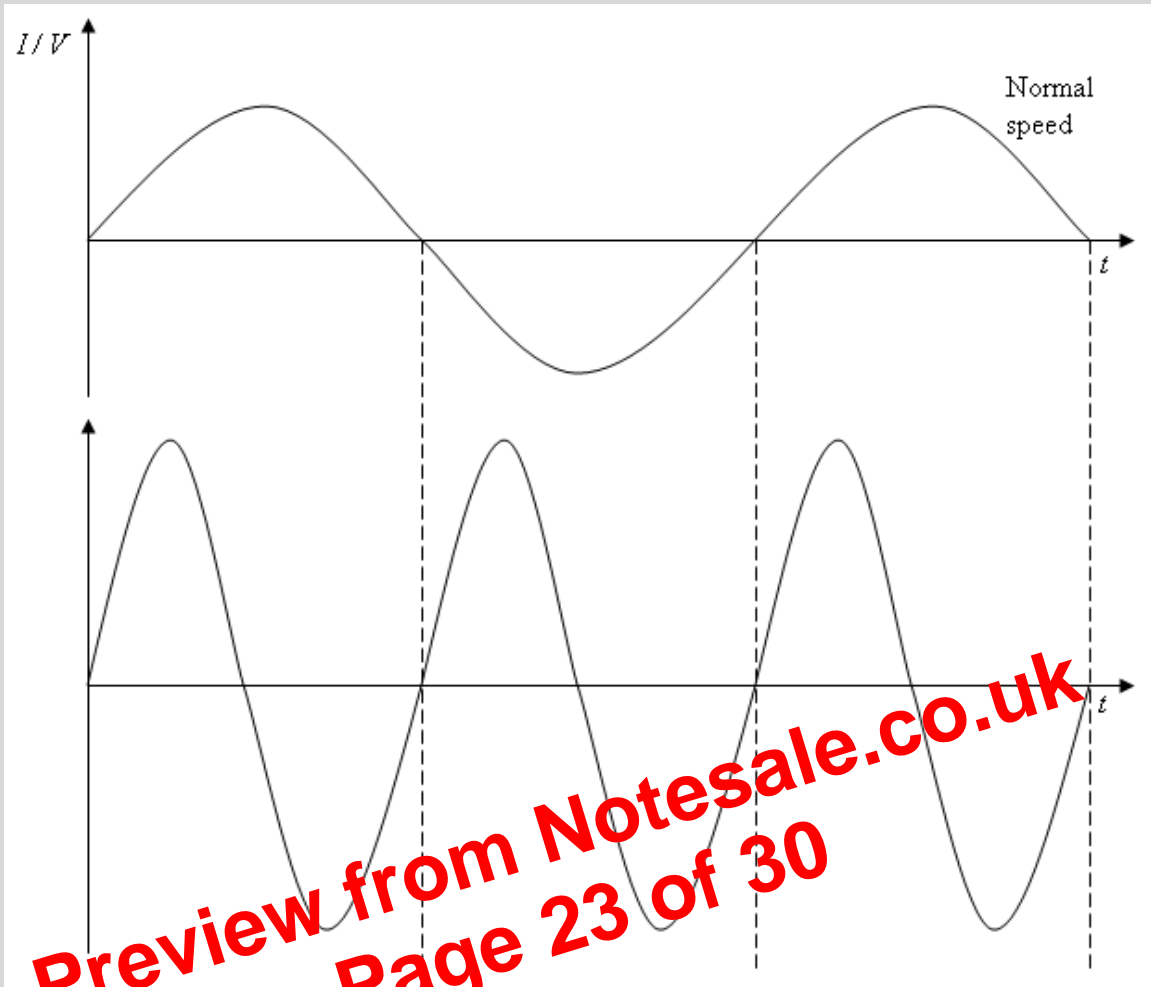


Gradient is $\frac{d\phi}{dt}$.

But from (1) and (3) whatever is the case $\epsilon = -\frac{d\phi}{dt}$ which shows that if gradient of ϕ and t is increasing, E.M.F is increasing and if it is decreasing ϵ is decreasing and if zero it is zero as well, so



Can you prove it mathematically? Yes look at the following working

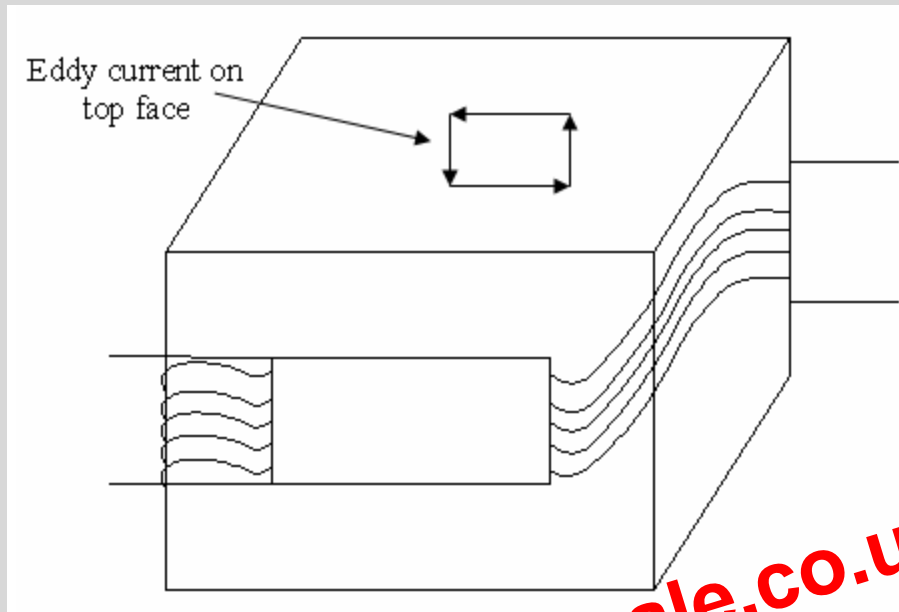


2. MAGNETIC FLUX DENSITY B :

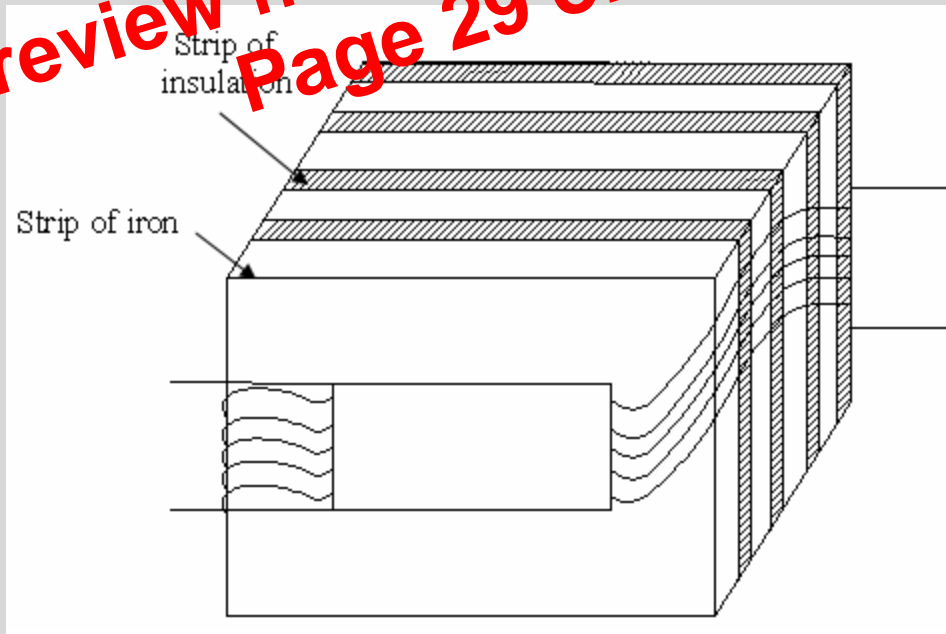
With more magnetic flux density B , there will be more disturbances hence more emf and current is generated but frequency is unaltered.

If you want to continue oscillations of same amplitude, you need to break flow of eddy current. This can be done by providing slits.

Eddy current is the disturbance in the transformer if made from continuous metal block as shown below.



This eddy current is produced in the walls which introduces secondary magnetic field opposing the primary one, hence resulting less efficient transformer. This is avoided by using laminated iron core which stops circulation of eddy current. Following figure gives the picture of laminated iron core.



Eddy current may work as an advantage as well. Following figure gives the working of electromagnetic brakes.