SNS COLLEGE OF TECHNOLOGY

Coimbatore-35

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University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19ECT201 –ELECTRICAL ENGINEERING & INSTRUMENTATION

II YEAR/ III SEMESTER

UNIT 2 – TRANSFORMERS

TOPIC 2 – PRINCIPLE OF OPERATION & EMF EQUATION OF TRANSFORMER

OVERVIEW

- BASIC RECAP QUESTION
- FARADAYS LAW
- PRINCIPLE OF OPERATION
- EMF EQUATION

BASICS RECAP

A current of 1A is drawn by a filament of an electric bulb for 10 minutes. Find the number of electrons that flows through the circuit.

ANS: The number of electron that flows through the circuit is 600

Step-by-step explanation:

we are given

current = 1 A

time = 10 min = 10 *60 sec = 600 sec

we have to find coulomb of charge so let it as x and formula for this is

$$I = \frac{Q}{T}$$

now put values

$$1\ A = \frac{x}{600\ sec}$$

1A * 600 sec = x coulomb

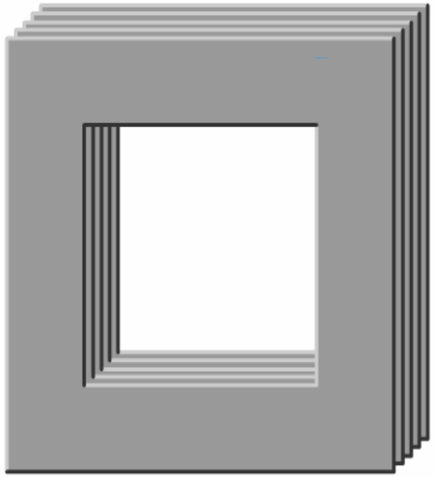
600 coulomb (or ampere/ sec) in this circuit 600 electrons flows for 10 min in 1 Ampere current .

KEY POINTS

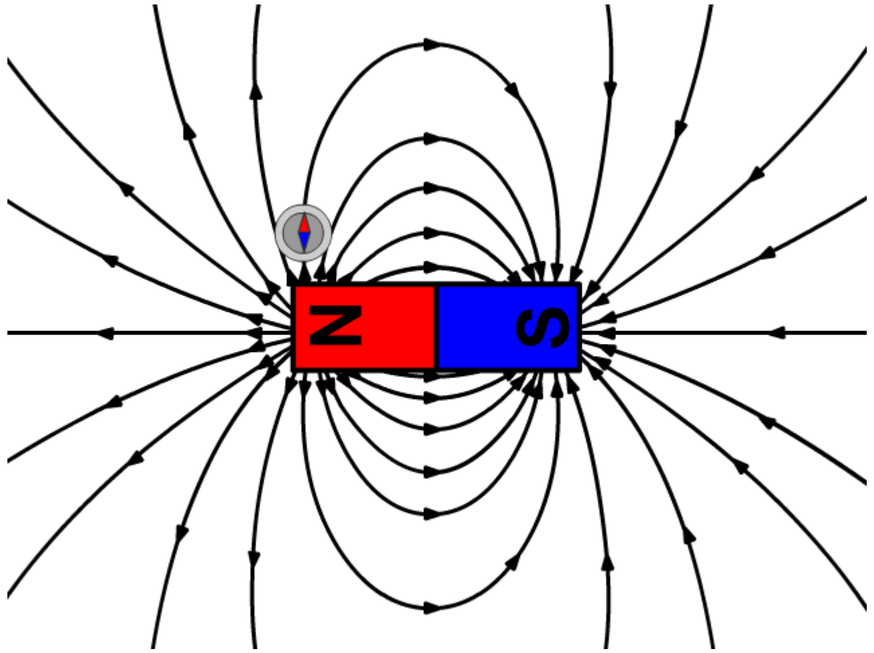
- FARADAYS LAW
- STATIC DEVICE
- MAGNETIC FLUX
- MUTUAL INDUCTANCE
- CORE
- LAMINATIONS
- RELUCTANCE

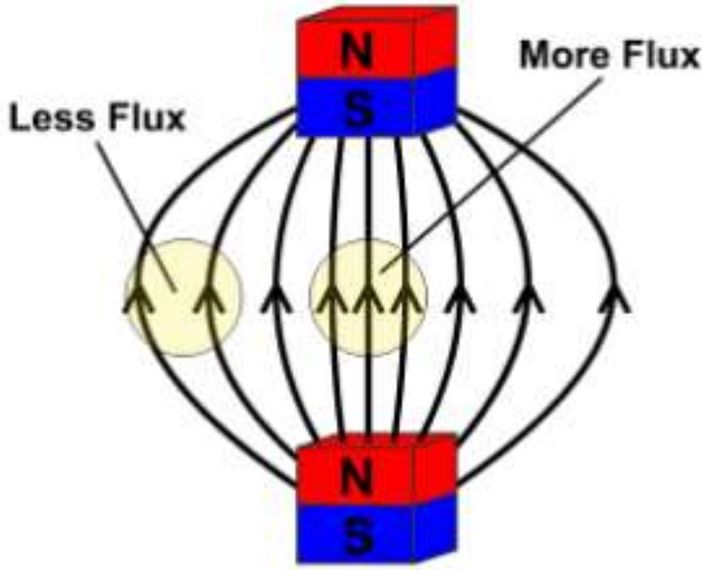
PRINCIPLE OF OPERATION-FARADAY'S LAW

Any Change in the magnetic field of a coil of wire will cause an EMF to be induced in the coil. This EMF induced is called induced EMF and if conductor circuit is closed, the current will also circulate through the circuit and this current is called induced current



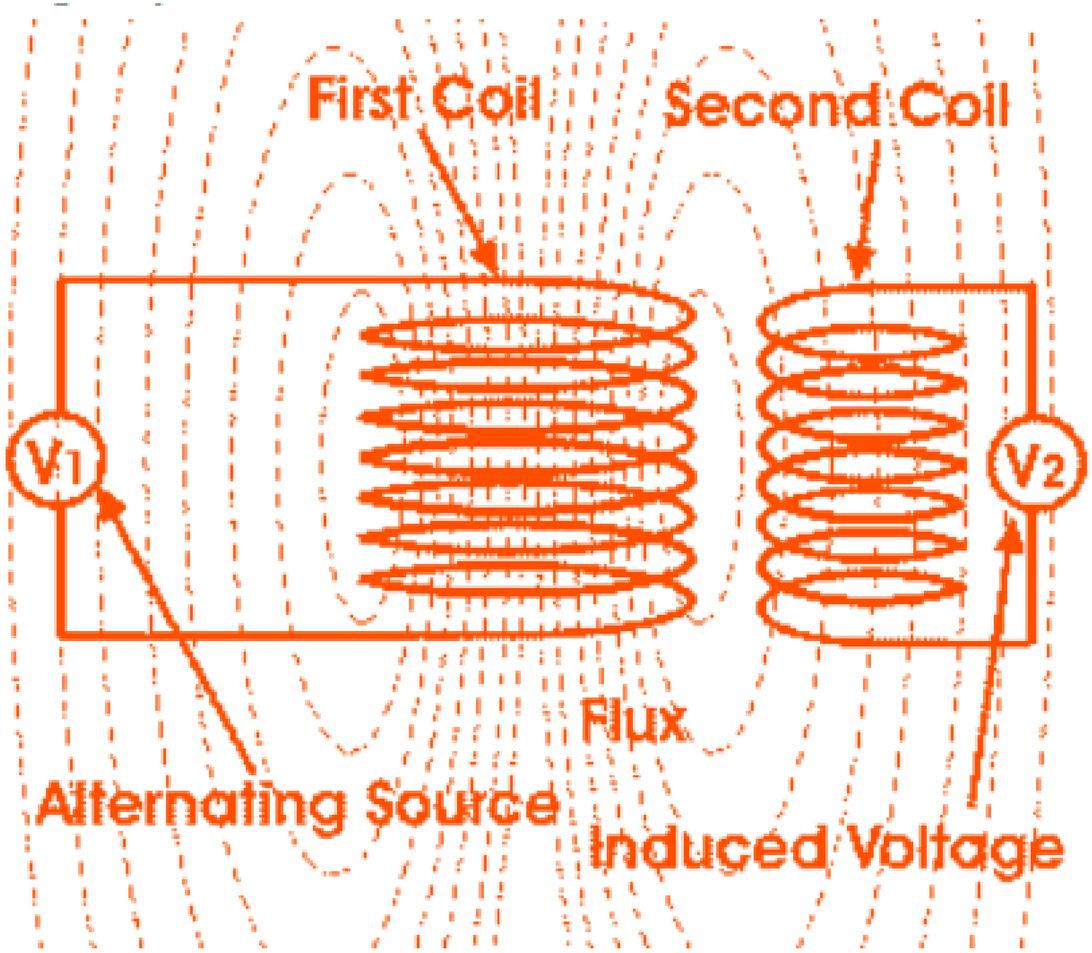
MAGNETIC FLUX





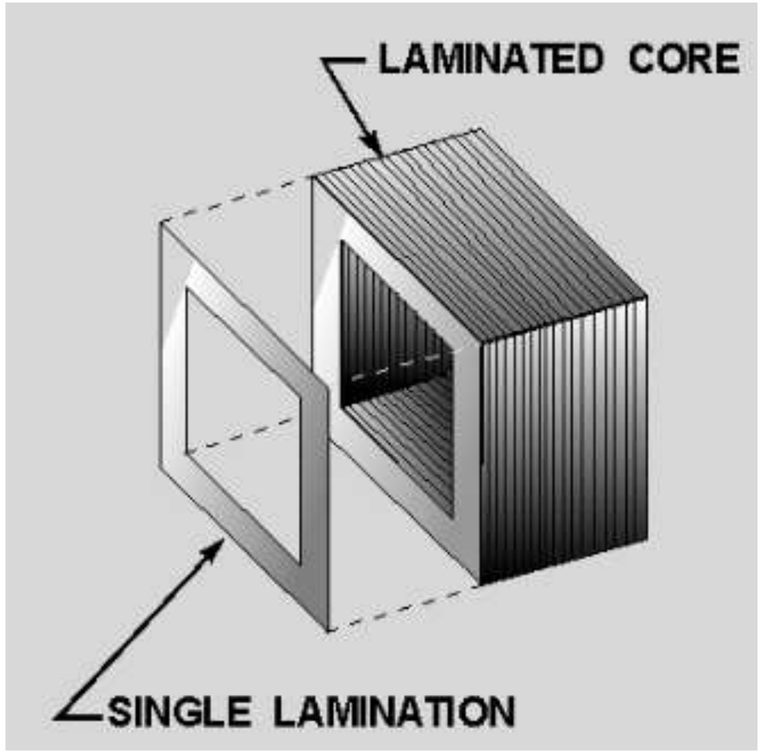
Magnetic Flux is a measure of the number of **magnetic field lines passing through a given point**.

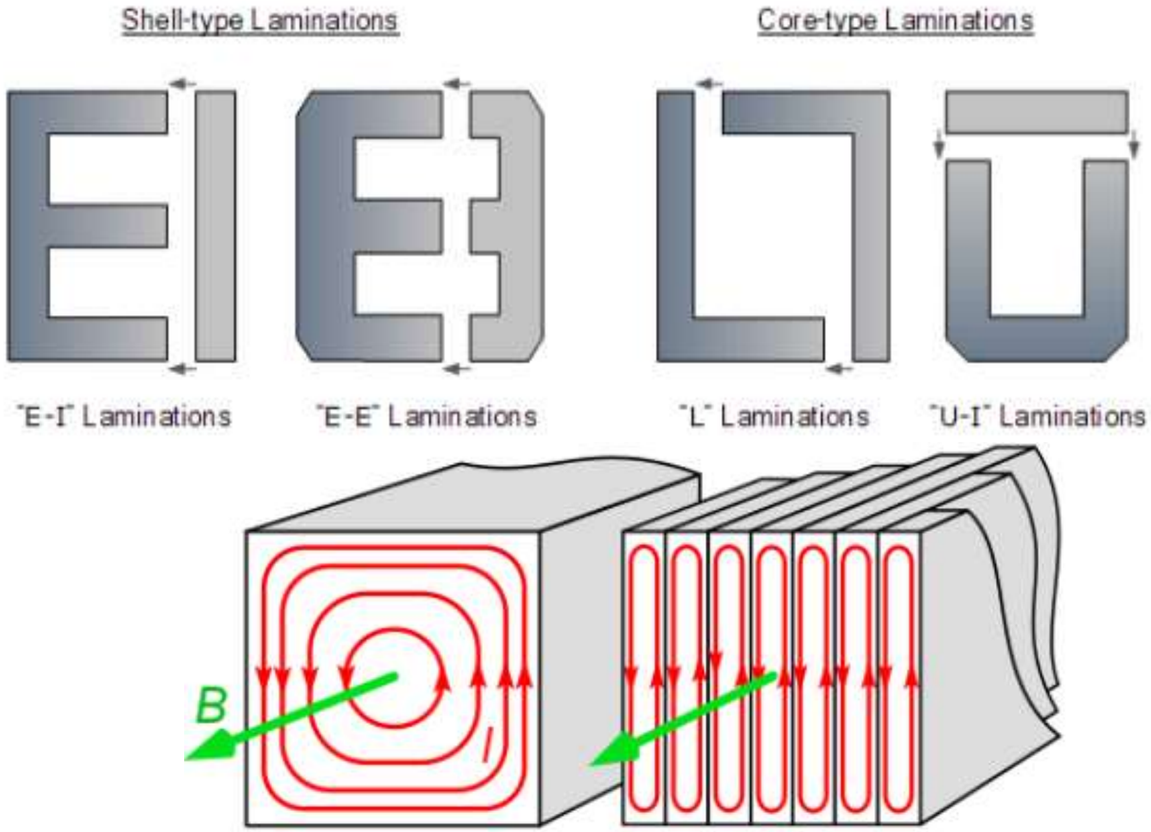
MUTUAL INDUCTANCE



Mutual Inductance is the property of two coils, by virtue of which, either of the two coils opposes any change in the strength of the current flowing through the other coil, by inducing an opposing emf in itself.

LAMINATED CORE

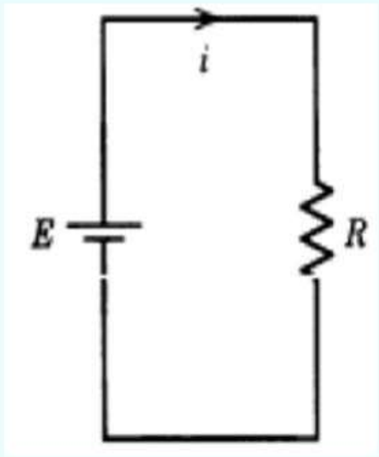


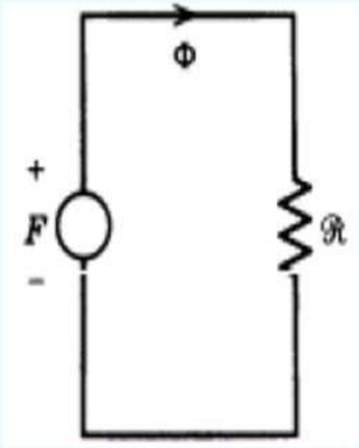


- Laminated sheets of steel are used to reduce eddy current loss.(I^2R Loss)
- Breaking a large core into narrow laminations reduces the power losses drastically

RELUCTANCE

Analogy between Electric circuit and magnetic circuit





Driving Force	Emf (E)	Mmf (F)
Produce	Current i	Flux Φ
Limited by	Resistance R	Reluctance

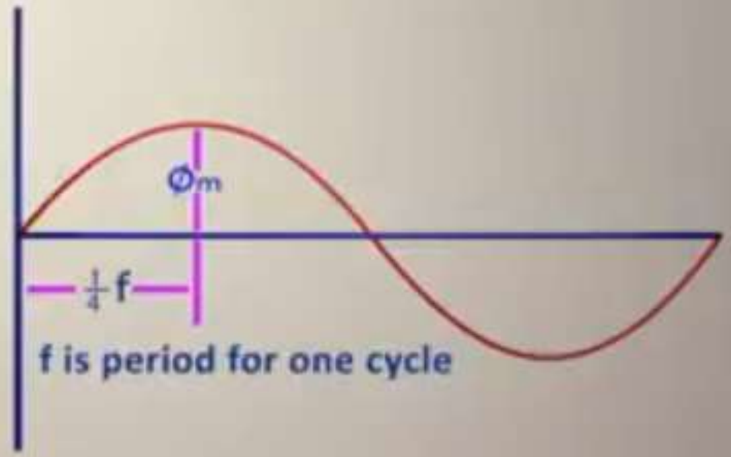
EMF Equation of a Transformer

N_1 = Number of Turns in Primary Winding

N_2 = Number of Turns in Secondary Winding

ϕ_m = Maximum Flux in the Core

f = Frequency of AC Input



Average rate of change of flux = $\frac{\phi_m}{1/4\ f} = 4\ f\ \phi_m$ Wb/s or volt

Average E.M.F / turn = $4\ f\ \phi_m$ volt

If flux ϕ_m varies sinusoidally,

Form Factor = $\frac{\text{R.M.S. value}}{\text{Average value}} = 1.11$

$\therefore$ R.M.S. value of E.M.F / turn = $4.44\ f\ \phi_m$ volt

Now, R.M.S. value of the E.M.F. in the whole of primary winding

= (induced E.M.F/turns) x No. of primary turns

$E_1 = 4.44\ f\ N_1\ \phi_m$

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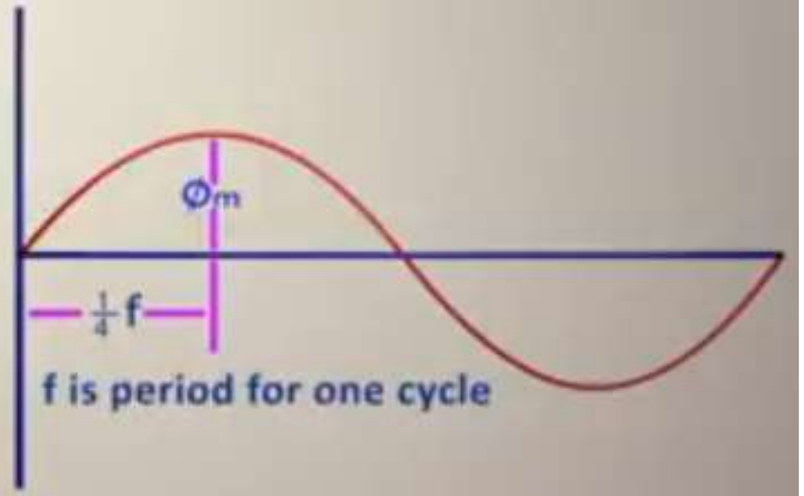

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$$E_1 = 4.44\ f\ N_1\ \Phi_m$$

$$E_2 = 4.44\ f\ N_2\ \Phi_m$$

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If flux Φ_m varies sinusoidally,

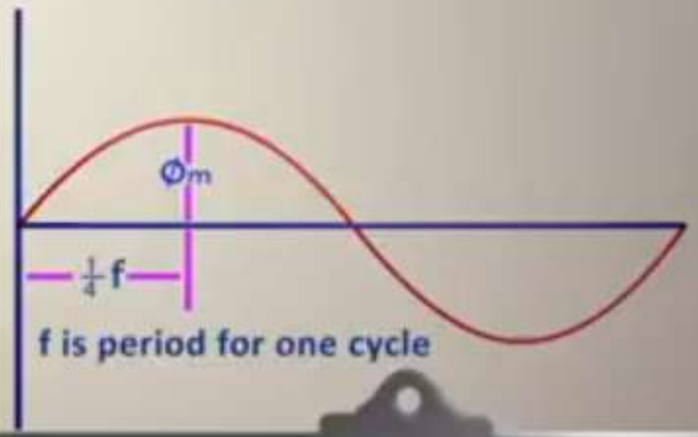
Form Factor = $\frac{\text{R.M.S. value}}{\text{Average value}} = 1.11$

∴ R.M.S. value of E.M.F / turn = $4.44\ f\ \Phi_m$ volt

$E_1 = 4.44\ f\ N_1\ \Phi_m$

$E_2 = 4.44\ f\ N_2\ \Phi_m$

$\frac{E_2}{E_1} = \frac{N_2}{N_1}$



Voltage Transformer Ratio (K)

$\frac{E_2}{E_1} = \frac{N_2}{N_1}$

If K > 1

'Step-up' transformer

Voltage Transformer Ratio (K)

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If K > 1 N2>N1

'Step-up' transformer

Voltage Transformer Ratio (K)

$$\frac{E_2}{E_1} = \frac{N_2}{N_1}$$

If K < 1 N2<N1

'Step-down' transformer

ASSESSMENT

What is Transformer?
Why Transformer is called Static Device?
Why the core is laminated?
What is self inductance and mutual inductance?
Which power source is used for providing alternating magnetic flux?
Which power source is used for providing Constant magnetic flux?


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