RAMA UNIVERSITY

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FACULTY OF ENGINEERING & TECHNOLOGY

Electrical Machine-1

Amit Kumar Singh

SINGLE PHASE TRANSFORMER

Principle of Operation

The primary of the transformer having *N1* turns is fed from an AC supply of *V1* volts. The current *I1* will flow through the primary coil. The current through the primary will set up a flux φ in the core. This flux, when linked with the primary winding, will produce an induced e.m.f., *E1,* in the primary.
The flux *φ* will pass through the core and link with the secondary winding to induce an e.m.f., *E2,* in the secondary winding. Because of this induced e.m.f., a current *I2* will flow through the load connected with the secondary winding. The load terminal voltage is *V2.*
If the input voltage *V1* is greater than the output voltage *V2,* then it is called the step-down transformer. If the input voltage *V1* is less than the output voltage *V2,* then it is called the step-up transformer.

EMF equation

Let N1 = No. of turns in primary N2 = No. of turns in secondary Φm = Maximum flux in core in webers = Bm × A

f = Frequency of a.c. input in Hz flux increases from its zero value to maximum value Φm in one quarter of the cycle i.e. in 1/4 f second.

∴Average rate of change of flux =1/ 4fΦm = 4 f Φm Wb/s or volt Now, rate of change of flux per turn means induced e.m.f. in volts.

∴ Average e.m.f./turn = 4 f Φm volt If flux Φ varies sinusoidally, then r.m.s. value of induced e.m.f. is obtained by multiplying the averagevalue with form factor. Form factor =r.m.s. value/ avg. value = 1.11

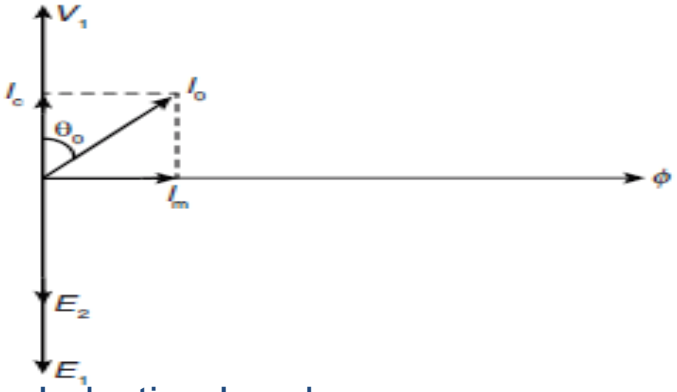
∴ r.m.s. value of e.m.f./turn = 1.11 × 4 f Φm = 4.44 f Φm volt • Now, r.m.s. value of the induced e.m.f. in the whole of primary winding = (induced e.m.f/turn) × No. of primary turns

•E1 = 4.44 f N1 Φm = 4.44 f N1 BmA.....(1)

Similarly, r.m.s. value of the e.m.f. induced in secondary is,

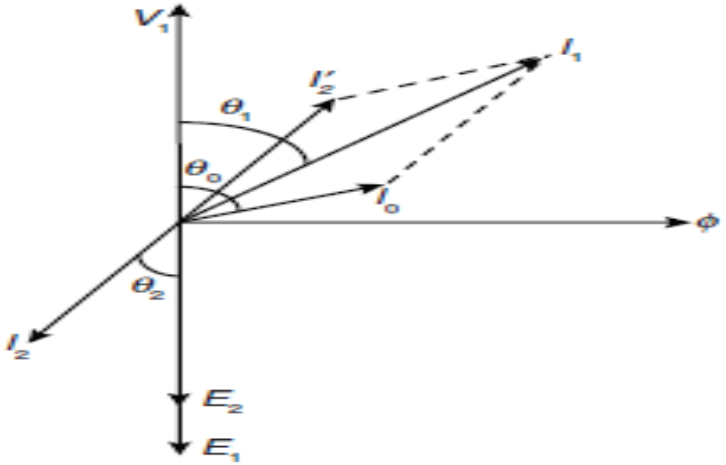
•E2 = 4.44 f N2 Φm = 4.44 f N2 BmA.....(2)

Practical Transformer on No Load



Inductive Load

i) The magnetisation component (*Im*), which is responsible for the production of flux in the core.
ii) The power component (*Ic*), which will supply the total losses.



Phasor Diagram of Transformer on Load

Capacitive Load