All day efficiency

As in case of distribution transformer load is varing through out the day i.e we may some time switch on the fan, light, Motor. So, Calculation of efficiency will be different at different out put load.

** So we calculate the efficiency at the end of the day called as All day efficiency

$$\eta_{all\ day} = \frac{\text{Energy o/p}}{\text{Energy i/p}} \times 100\%$$

Distribution transformer

But for power transformer loading is fixed at full load so there we calculate normal efficiency.

$$\eta_{all\ day} = \frac{\text{out put in KWh}}{\text{Input in KWh}} \quad (\text{for 24 hr})$$

** Distribution transformers have their primaries energised all the 24 hrs although their

secondaries supply little or no-load much of the time during the day except during the house lighting Period.

** It means the core loss occure through out the day, the cu loss occurs only when the transformers are loaded.

So, A good practice to design such transformers so that core losses are minimum The cu losses are relatively less important, because they depend on the load.

** The performance of such is compared on the basis of energy consumed during a certain time period, usually a day of 24 hrs.

Steps for Solving Numericals

(i) Find out the output KWh. i.e if output KW is given for specific hrs multiplay output KW to hr and add them all.

ex

No of hours	loading in KW	Power factor
6	400	0.8
10	300	0.75
4	100	0.8
4	0	—

output KWh = $400 \times 6 + 300 \times 10 + 100 \times 4 + 0 \times 4$.

= 5800 KWh

(ii) Core loss = Core loss in KW $\times$ 24 hr for 24 hr

** As core loss occurs for 24 hr in a day.

ex If iron loss at full load is 3.5 KW then

iron loss / core loss for 24 hr

$= 3.5 \text{ KW} \times 24 \text{ hr}$

$= 84 \text{ KWh}$

(iii) Cu loss for 24 hr depend upon the loading.

ex If full load (500 KVA) Cu loss is 4.5 KW then according the loading data

for 500 KVA Cu loss at F.L = 4.5 KW

for 6 hr Cu loss the KVA is $\frac{KW}{P.F} = \frac{400}{0.8}$

$= 500 \text{ KVA}$ (Full load)

$= x^2 P_{cu\,fl}$

$= 1 \times 4.5 \text{ KW}$

$= 4.5 \text{ KW}$

For 10 hr Cu loss the KVA is $\frac{KW}{PF} = \frac{300}{7.5}$

$= 400 \text{ KVA}$

$= x^2 P_{cu\,fl}$

$= \left(\frac{400}{500}\right)^2 \times 4.5 = 2.88 \text{ KW}$

For 4 hr the Cu loss the KVA is

$$\frac{KW}{P.F} = \frac{100}{0.8} = 125 \text{ KVA}$$

Cu loss $= x^2 P_{cu} \times t$

$$= \left(\frac{125}{500}\right)^2 \times 4.5$$

$$= 0.281 \text{ KW}$$

** x is the fraction KVA

$$= \frac{\text{KVA loading}}{\text{KVA full load}}$$

Note: Transformer is rated interms of KVA but the output is interms of KW already discussed.

So, Now find out the Cu loss for 24 hrs.

Total Cu loss for 24 hrs

$$= (6 \times 4.5) + (10 \times 2.88) + (4 \times 0.281) + (4 \times 0)$$

$$= 56.924 \text{ KWh}$$

(iv) $\eta_{all\ day} = \dfrac{\text{out put kWh}}{\text{In put kWh}}$

$= \dfrac{\text{out put kWh}}{\text{out put kWh + losses}}$

$= \dfrac{5800}{5800 + \text{Core loss in 24 hr} + \text{Cu loss in 24 hr}}$

$= \dfrac{5800}{5800 + 84 + 56.924}$

$= \dfrac{5800}{5800 + 140.924} = 0.976$ or 97.6%.

Power transformer	Distribution Transformer
(i) operate above 33 KV	(i) operate below 33 KV
(ii) operate at full load	(ii) operate at 50 to 70 % of load.
(iii) Load is fixed i.e full load. (Load is not directly connected)	(iii) Loading is variable (Load is directly connected)
(iv) Main criteria is to minimise cu loss. as it is operate on full load.	(iv) Main criteria is to minimise iron loss as it occure for 24 hr.
(v) connected in star-delta or delta-delta	(v) Always connected in delta-star for the availability of Neutral point.
(vi) More flux density.	(vi) Less flux density.
(vii) Efficiency is Max^m at full load.	(vii) Efficiency is Max^m at 50 to 70 % of load.
(viii) Step up and step down operation	(viii) only step down operation.
(ix) Transmission & Receiving	(ix) Distribution only. (end transformer)
(x) Cost and size More.	(x) Less