INSTRUMENT TRANSFORMERS

Transformers used in conjunction with instruments for measurement are called Instrument Transformers.

Instrument Transformers are of two types

= Current (or Series) Transformers

= Potential (or parallel) Transformers.

Gen principle is the same as of power transformers

MAIN DIFFERENCE : They are required to transform relatively small amounts of power. as Their only load (called burdens) are delicate moving elements of instruments.

Use of CT and PT become essential as there are several drawbacks of use of 'Shunts' in ammeters and the use of multipliers in voltmeters.

Drawback of Shunts.

i) It is difficult to achieve accuracy with a shunt on a.c. Since division of current depends upon ratio of reactance to resistance of two paths. For proper measurement Time constant of meter and shunt should be same. Error is serious when frequency varies.

ii) Method of using shunts is limited to capacities of a few hundred amperes al-most as power consumed by shunts shall be enormous

iii) Problem of insulation between instrument and shunt if measurement are done at higher voltages

iv) No isolation of measuring circuit and the power circuit.

Disadvantage of Multiplier (in case of voltmeter)

i) Power consumed in multipliers becomes very large as voltage increases

ii) Possibility of leakage currents when measuring high voltages.

iii) Isolation of measuring circuit and power circuit not possible

iv) Insulation of meters and multipliers is difficult and expensive.

Advantage of Instrument Transformers.

i) When instrument transformer are used the single range instrument is able to cover large current or voltage range

ii) Measuring instrument could be located at a remote place.

iii) When Instruments are used in conjunction with instrument transformers their reading do not depend on their constants (R, L, C) as in the case of multipliers. Instrument transformers produce practically the same instrument reading regardless of constants of instruments (or a number of instruments which could be connected to it.

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iv) With standardization of CT and PT secondary windings it is possible to standardize instruments around these ratings
v) The measuring circuit is isolated from the power circuit
vi) Several instruments could be operated from a single instrument transformer
vii) Less Power loss
viii) Response of shunts in a.c. shall not be linear where as it is linear in case of instrument transformers

Difference between Instrument transformer & Power transformer

The main difference between the two transformers is their VA ~~rating~~ rating

Power Transformers have high KVA rating (500 KVA, 1000 KVA, upto 1000 MVA) as their main function is to transform power

however

Instrument transformers have rating of only a few tens of VA (eg. 10VA, 30 VA, 100VA) and therefore, they are not used to transfer power.

Categories / classes of Instrument transformers

There are two classes of Instrument transformer

① Measuring Transformers
② Protective Transformers

Measuring Transformers are used in conjunction with measuring devices such as ammeters, wattmeters, KVA & KWH meters.

Protective transformers ~~are~~ are used for providing protection devices along with over current relay, Earth Fault Relay, Differential relay, Impedance relay etc.

Our scope of study at this stage will be limited to Study of Measuring transformers.

Current Transformer
Study and phasor diagrams.

(4) CURRENT TRANSFORMERS

Primary winding is designed to be connected in series with the line so impedance of primary winding is made as small as possible. As CT is normally connected to measure current (not always necessary) the secondary has more turns than the primary, so we can say it is usually a step up transformer.

Its role is quite different from power transformers. The load impedance ie 'burden' on the secondary is very small ② so practically the C.T. operates on short circuit conditions. Also the ③ current in the secondary does not depend on the load condition on the secondary but depends upon the current flowing in the primary winding ie main circuit.

① Power handled by CT is small. The product of voltage and current on the secondary side when the CT is supplying the instrument with its max rated value of current is known as 'Rated burden' and is measured in V.A. Usual rating of CT is very small eg 15 VA in no case exceeds 30 VA.

Core of CT is laminated iron (High p steel). It has large number of fine insulated wire for secondary. Secondary is usually designed to carry a current of 5A. Over the secondary winding are wound 2 or 3 thick insulated wire or strip of copper. Diemension of wire in primary depends on primary current. Large rating primary consist of a straight conductor which passes through the centre of a hollow metal core. Secondary is wound on core. It is called Bar Type CT (100A or larger). Some CT may not have a primary, Sec is wound over a ring shaped core through which the cable passes. Cable serves as a single turn primary.