RAMA UNIVERSITY

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FACULTY OF ENGINEERING & TECHNOLOGY

Electrical Machine-1

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Construction of three phase transformers

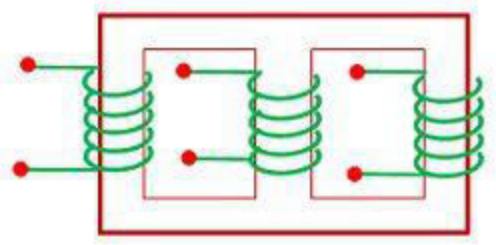
A three phase transformer is used to transfer a large amount of power. The three phase transformer is required to step-up and step-down the voltages at various stages of a power system network. The three phase transformer is constructed in two ways.

1. Three separate single phase transformer is suitably connected for three phase operation.
2. A single three-phase transformer in which the cores and windings for all the three phases are merged into a single structure.

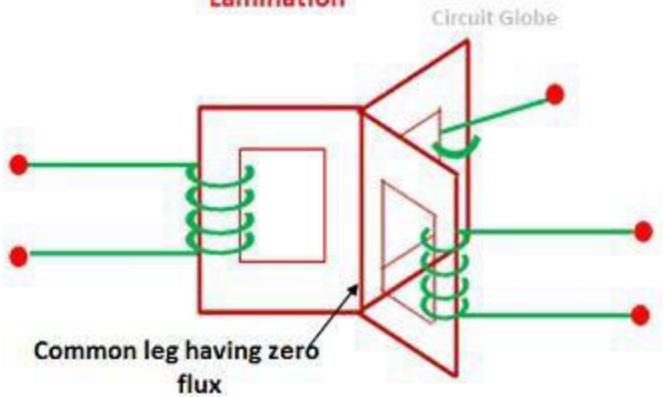
The three phase transformer is mainly classified into two types, i.e., the core type transformer and the shell type transformer.

Core Type Three Phase Transformer

Consider a three single phase core type transformer positioned at 120° to each other as shown in the figure below. If the balanced three-phase sinusoidal voltages are applied to the windings, the fluxes φ_a, φ_b and φ_c will also be sinusoidal and balanced. If the three legs carrying these fluxes are combined, the total flux in the merged leg becomes zero. Consider a three single phase core type transformer positioned at 120° to each other as shown in the figure below. If the balanced three-phase sinusoidal voltages are applied to the windings, the fluxes φ_a, φ_b and φ_c will also be sinusoidal and balanced. If the three legs carrying these fluxes are combined, the total flux in the merged leg becomes zero. This leg can, therefore, be removed because it carries the no flux.



Core Structure Using Stacked Lamination

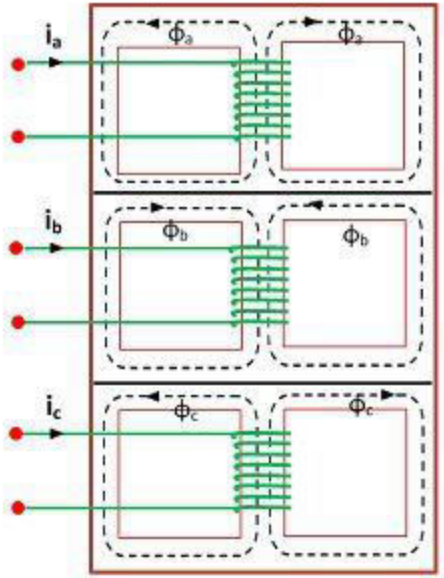


Three Single Phase Core in Contact With Another

Shell type Three Phase Transformer

The shell type 3-phase transformer can be constructed by stacking three single phase shell transformer as shown in the figure below. The winding direction of the central unit b is made opposite to that of units a and c. If the system is balanced with phase sequence a-b-c, the flux will also be balanced.

The magnitude of this combined flux is equal to the magnitude of each of its components. The cross section area of the combined yoke is same as that of the outer leg and top and bottom section of the yoke. The imbalance in the magnetic path has very little effect on the performance of the three shell-type transformers. The windings of the shell type three phase transformer are either connected in delta or star as desired.



3-Phase Shell Type Transformer

Circuit Globe

Accessories of Transformers

For providing long service life to the transformer, different *transformer accessories* get fitted with it.

Breather of Transformer

When the temperature changes occur in transformer insulating oil, the oil expands or contracts and there an exchange of air also occurs when transformer is fully loaded. When transformer gets cooled, the oil level goes down and air gets absorbed within. This process is called breathing and the apparatus that pass through the air is called breather. Actually, silica gel breathers controls the level of moisture, entering electrical equipment during the change in volume of the cooling medium and/or airspace caused by temperature increasing.

Conservator Tank of a Transformer

This is a cylindrical tank mounted on supporting structure on the roof of the transformer's main tank. When transformer is loaded, the temperature of oil increases and consequently the volume of oil in the transformer gets increased. Again; when ambient temperature is increased, the volume of oil is also increased. The conservator tank of a transformer provides adequate space for expansion of oil. Conservator tank of transformer also acts as a reservoir of oil.