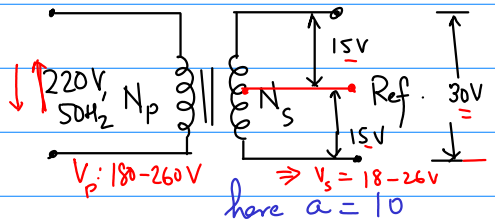
09.06.2022

Transformer Taps & Autotransformer

Turn ratio, $a = \frac{N_p}{N_s}$ = fixed



here $a = 10$

$V_s = \frac{V_p}{a} = \frac{220V}{10}$

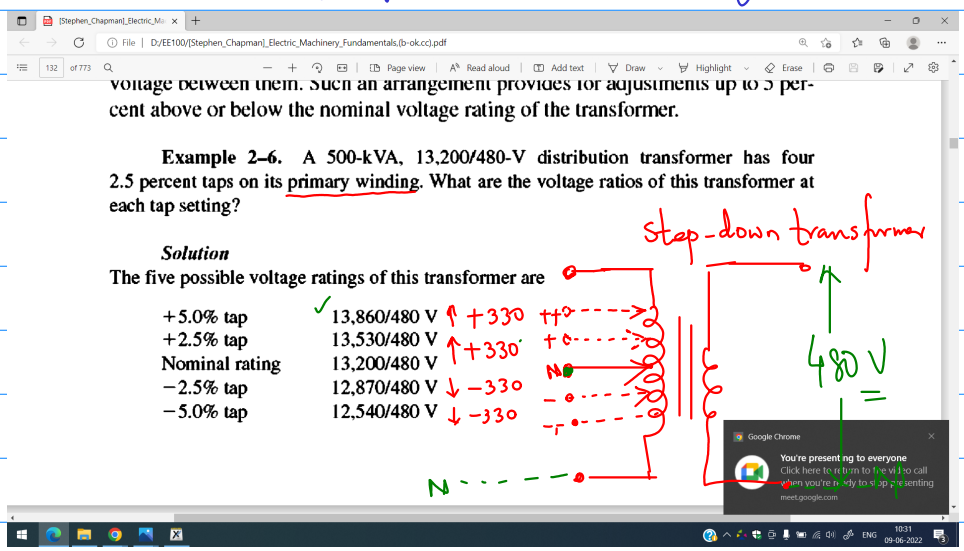
$\Rightarrow V_s = 22V$

$\frac{V_p}{V_s} = a$; $\frac{I_p}{I_s} = \frac{1}{a}$

Once, the no. of turns in primary/secondary is fixed.

a = fixed.

So, tapping of a winding (either primary/secondary) helps in changing the value of turn-ratio 'a'.



2.5% 13,200

$\frac{25}{1000} \times 13,200$

330.0

$a_N = \frac{13200}{480} = 27.50$ ✓

$a_+ = \frac{13530}{480} = 28.18$ ↑.

$a_{++} = \frac{13860}{480} = 28.80$ ↑↑

$$a_{-} = \frac{12,870}{480} = 26.81 \downarrow$$

$$a_{--} = \frac{12,540}{480} = 26.12 \Downarrow$$

- Once the tap is fixed, the turn-ratio is also fixed and one cannot change the tap while the transformer in operation.

- However, in many applications wherein you require controlled voltage with changing the supply voltage.

  For this we use specially designed transformer called Tap changing under load (TCUL) transformer.
  - Such transformer (also called voltage regulator) changes its tap automatically whenever there is change in the supply voltage (↑↓).

Autotransformer

Whenever change in voltage level is required only by a small amount.

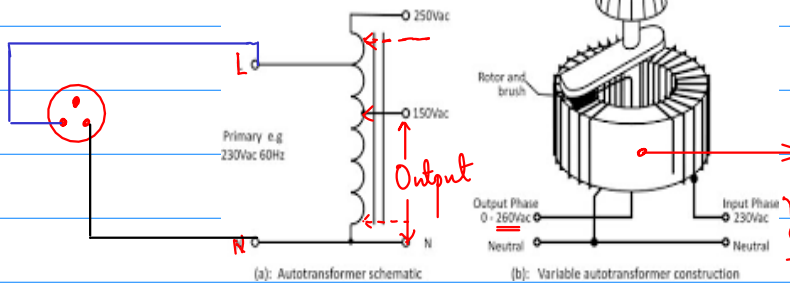
220V ← Gradual step-down — 230V — Gradual step-up → 240V, 245, 250V

210V

Autotransformer

→ Supply (230V, 50Hz)

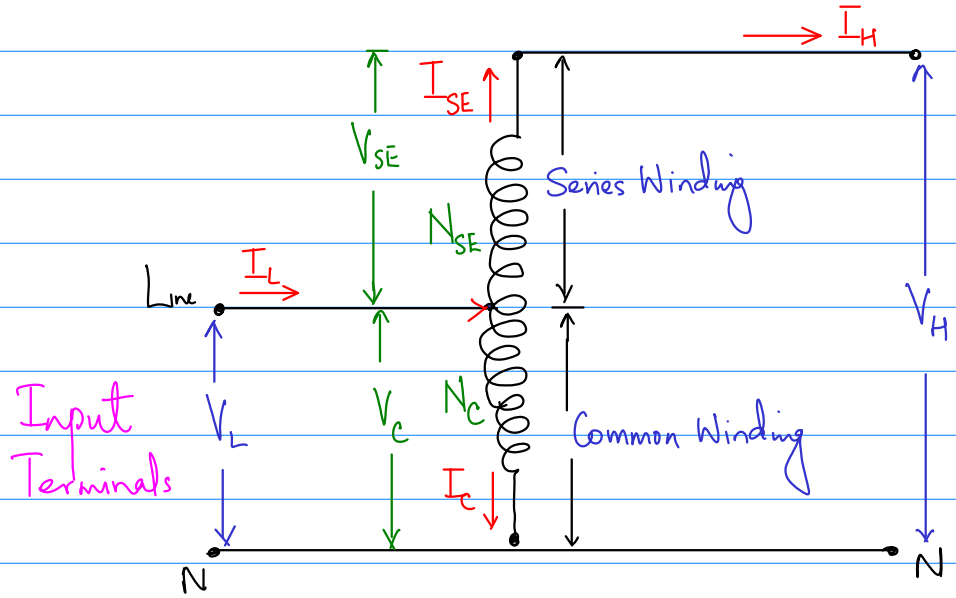
Construction:



gradual rotation will change the output voltage!

Magnetic Core (Cylindrical)

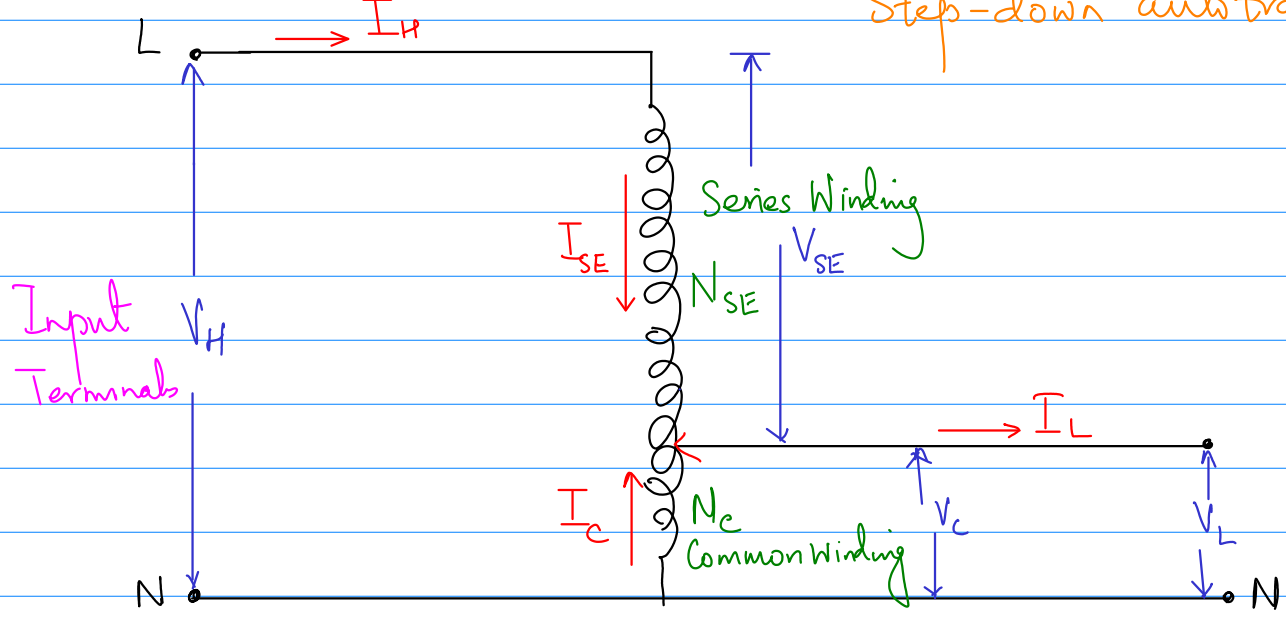
} Input Voltage



Input Terminals

Step-up autotransformer Output terminals

Step-down autotransformer



Output terminals

Important relationships b/w voltages / currents.

1. $\frac{V_C}{V_{SE}} = \frac{N_C}{N_{SE}} =$ variable (depends upon the positioning the control knob)

2. $N_C I_C = N_{SE} I_{SE} \Rightarrow \frac{I_C}{I_{SE}} = \frac{N_{SE}}{N_C} =$ variable

3. Low-voltage terminal : $V_L = V_C$

4. High-voltage terminal : $V_H = V_C + V_{SE}$

5. $I_H = I_{SE}$

6. $I_L = I_C + I_{SE}$.

Reference: Section 2.9