

Three-phase Systems

	Star connection	Delta connection
Voltage	$V_L = \sqrt{3} V_{ph}$	$V_L = V_{ph}$
Current	$I_L = I_{ph}$	$I_L = \sqrt{3} I_{ph}$

Active and reactive power in three phase systems:

$$P_L = \sqrt{3} V_L I_L \cos \varphi \quad Q_L = \sqrt{3} V_L I_L \sin \varphi$$

Capacitive reactive power for reactive power compensation:

$$Q_C = P_L (\tan \varphi_1 - \tan \varphi_2)$$

Full load voltage regulation (VR):

$$VR = \frac{V_{L-NL} - V_{L-FL}}{V_{L-FL}} \times 100$$

Induction motors

Rotor speed and rotor slip of induction motor:

$$n_r = (1 - S)n_s \quad S = \frac{n_s - n_r}{n_s}$$

Converted power in induction motor:

$$P_{Conv} = (1 - S)P_{AG}$$

Rotor copper loss:

$$P_{RCL} = 3R'_2(I'_2)^2 = SP_{AG}$$

Rotor speed in rad/sec:

$$\omega_r = n_r \frac{2\pi}{60}$$

Load torque and induced torque of induction motor:

$$\tau_{load} = \frac{P_{out}}{\omega_r} \quad \tau_{ind} = \frac{P_{AG}}{\omega_s}$$

Synchronous machines:

Internal voltage of synchronous generator:

$$E_A = K \varphi \omega$$

Output power of synchronous generator:

$$P_{out} = \frac{3V_T E_A \sin \delta}{X_s}$$