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(AUTONOMOUS)
Department of Electrical & Electronics Engineering

24EE202
Fundamentals of Electrical and Electronics Engineering

UNIT II

AC CIRCUITS AND MAGNETIC CIRCUITS

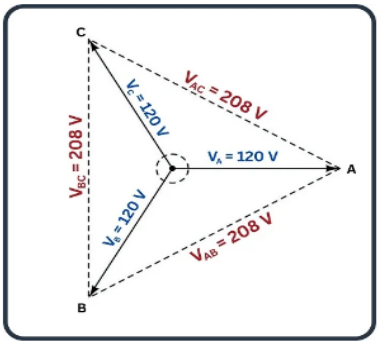
AC CIRCUITS

- Introduction to poly-phase circuits
- Representation of sinusoidal waveform
- Peak and rms values,
- Real power, reactive power, apparent power, power factor.
- Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations
- Converters: rectifiers and inverters

MAGNETIC CIRCUITS

- Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density, fringing
- Self and mutual inductances and coefficient of coupling

Introduction to poly-phase circuits

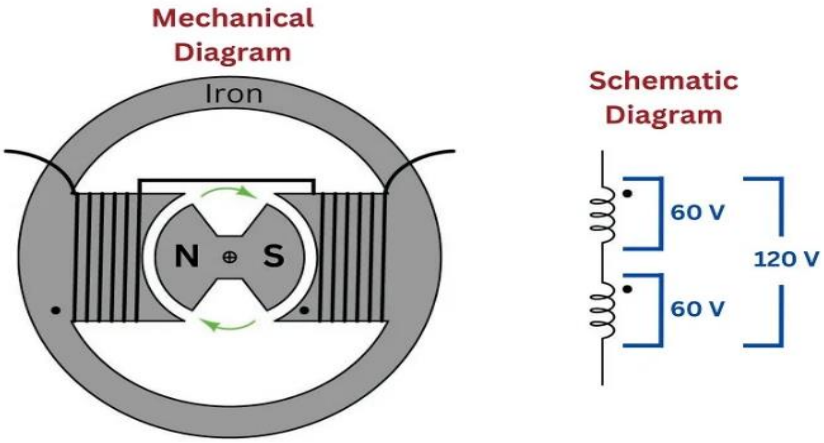


Three phase AC power is the most common form of industrial voltage service. Polyphase power is produced and consumed with care given to balance the various legs to preserve power quality.

"Polyphase" means "many phases," describing a form of AC electrical system where multiple sinusoidal voltages exist that are not in step with each other. The most common form of polyphase AC power in industry is *three-phase*, but all polyphase systems share similar traits. A good way to understand three-phase AC systems is to begin with an understanding of simpler, single-phase systems.

Single Phase AC

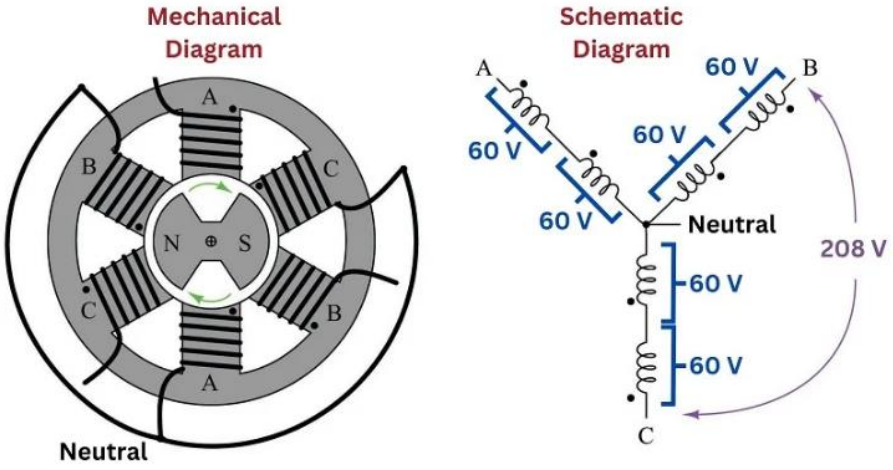
A simple *alternator* (AC generator) is nothing more than a magnetized rotor spinning between a pair of electromagnetic poles, the stationary wire coils ("stator windings") developing AC voltage as the spinning rotor's magnet passes by:



Note that the stator is comprised of two windings connected in series-aiding fashion, so that their respective AC voltages directly add. If each winding of this machine develops 60 volts, the series pair will develop 120 volts. This machine is properly called a *single-phase* alternator, because all its stator winding voltages are in-phase with each other.

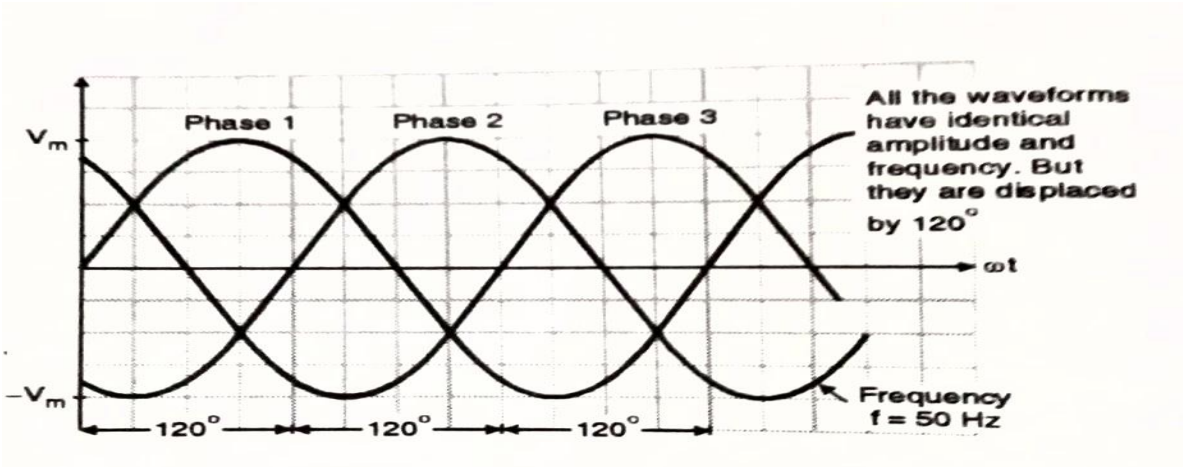
Three Phase AC

A much more common alternator design uses three sets of stator poles, each one with its own winding pair, to generate three AC voltages phase-shifted from one another by 120^o. The reason these three AC voltages are not in-phase with each other is precisely because the three stator poles are not physically aligned with each other, which means the magnetic poles of the spinning rotor will pass by each stator pole pair at different times:



Note that each pair of stator winding voltages directly add, because they are in phase with each other. In the example shown, each individual stator winding develops 60 volts, with each series-aiding pair (each "phase" of the alternator) developing 120 volts. However, the voltage appearing between different stator winding pairs is neither the simple sum $(120 + 120)$ nor the simple difference $(120 - 120)$ of each phase voltage. Rather, the phase-to-phase voltage is the *trigonometric sum* of two phasor quantities, spaced 120^o apart. In the example shown, $120\angle 0^o + 120\angle 120^o = 207.85\angle 60^o$, which is approximately 208 volts. This machine is properly called a *three-phase* alternator. More specifically, this alternator is one with a *wye-connected* stator winding set, because the geometric configuration of the stator windings resembles that of the letter "Y".

Three Phase Wave form



Three Phase Supply:

Three Voltages with a Same magnitude and frequency and having a phase difference of 120° between them.