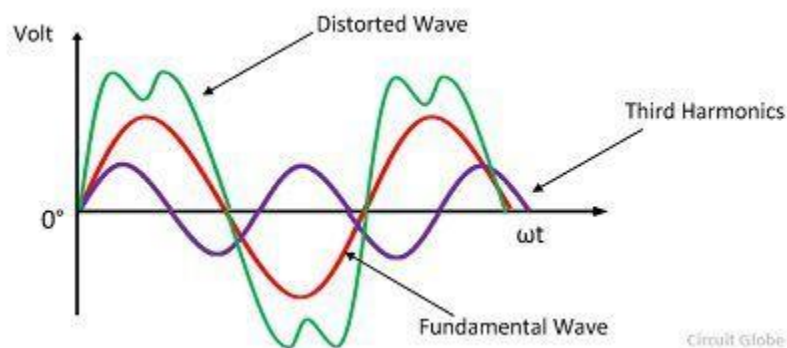


# Harmonics

The harmonic is the distortion in the waveform of the voltage and current. It is the integral multiple of some reference waves. The harmonic wave increases the core and copper loss of the transformer and hence reduces their efficiency. It also increases the dielectric stress on the insulation of the transformer. It also causes several other problems in power circuit components such as motors, transformers and capacitor banks.

In a three-phase transformer, the non-sinusoidal nature of magnetizing current produces sinusoidal flux which gives rise to the undesirable phenomenon. The phase magnetizing currents in transformer should contain third harmonics and higher harmonics necessary to produce a sinusoidal flux.



Such altered waveforms may be mathematically analyzed using Fourier transforms as a combination of vectors of the power frequency (50/60 Hz) and others whose frequency is a multiple of the power frequency.

The harmonic currents flowing through the various loads of the system give rise to several abnormalities.

Equipment	Effects of harmonics
Capacitors	Amplify harmonics on electrical distribution system.
Electrical wiring	Phase and neutral conductors undersized.
Engine generators	Transferring capability and operation disrupted.
Induction motors	May fail prematurely due to fifth harmonic
Metering	Inaccurate measurement of power
Overcurrent protection	Breaker and fuse nuisance tripping

Sensitive electronic loads	Voltage drop between neutral and earth
Transformers	Decreased efficiency and overheating
Uninterruptible power systems	Line and load interaction

Shunt Filters are commonly used to eliminate Harmonics. Several such tuned banks (one for each harmonic frequency) may be needed to totally divert all harmonics away from the system. However, for practical reasons, only a few of the lower order harmonics with larger magnitudes are filtered out, which is adequate to provide substantial reduction of harmonic content.