Power Factor

Power factor may be defined as :

- For sinusoidal waveforms, the power factor is the cosine of the phase angle (φ) between voltage and current.
- Power factor is the ratio of resistance to impedance. i.e $\cos\varphi = R/Z$
- Power factor is the ratio of active power to apparent power.
  i.e. $\cos\varphi = V I \cos\varphi / VI$.

Since Active Power is given by, $P = V I \cos\varphi$ watts,

Hence $\cos\varphi = P/VI$……(i)

Equation (i) shows that the current 'I' is affected by the power factor.

The supply voltage "V" is kept fairly constant. Hence for a given Power "P" required by the load, the current "I" drawn by the load varies inversely as the load power factor "$\cos\varphi$"

Thus, a given load takes more current at a low power factor.

Problems of Low Power Factor:

Low power factor draws more current, hence following problems may occur.

(i) Higher currents give rise to copper losses in system and therefore, the efficiency of the system is reduced.
(ii) Higher currents produce large voltage drop in cables and other apparatus. This results in poor voltage.
(iii) Higher currents require large cables, alternators, transformers etc. Thus the capital cost of the equipment is increased.

Causes of Low Power Factor:

The general cause of low power factor is due to inductive loads (current in inductive load lags behind the voltage). In the inductive loads power factor is lagging.

The important inductive loads responsible for low power factor as follows-

(i) Arc Lamps, electric discharge lamps, welding equipment.
(ii) Single phase induction motors operate at as power factor of around 6, while three phase induction motors operate at power about 0.8 lagging at full load. At light loads these motors work at very small power factor of the order of 0.2 to 0.3 lagging.
(iii) In case of transformer at light loads the primary current power factor is low.

Power Factor Improvement:-

The basic principle of power factor improvement is to inject a leading current into the circuit so as to neutralize the effect of lagging current.

The power factors may be improved by the following methods-

(i) By using synchronous Motor.
(ii) By using Static Capacitors.