NOTES -Class 34
Power factor Improvement

Ideally, Power factor of the system must be unity. Since most of the industrial loads are inductive in nature (Motor Loads) & they draw reactive power, power factor is usually less than unity & lagging in nature.

Electricity supply company asks industries to install capacitor banks to improve power factor by locally meeting their reactive power requirements and maintain power factor at a value above 0.9 Lag. This helps Electricity supply company in many ways

i) Overall System Size decreases, hence, saves lot of capital

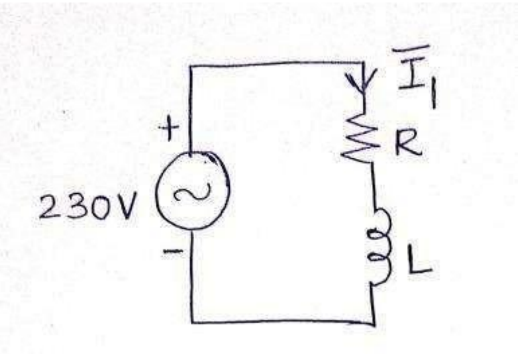
ii) Efficiency of the overall system increases

Numerical Example:

Question

The power consumed in the inductive load is 2.5 kW at 0.71lagging power factor .The input voltage is 230 V, 50 Hz. Find the value of the capacitor C which must be placed in parallel, such that the resultant power factor of the input current is 0.866 lagging.

Solution:



(CASE 1)

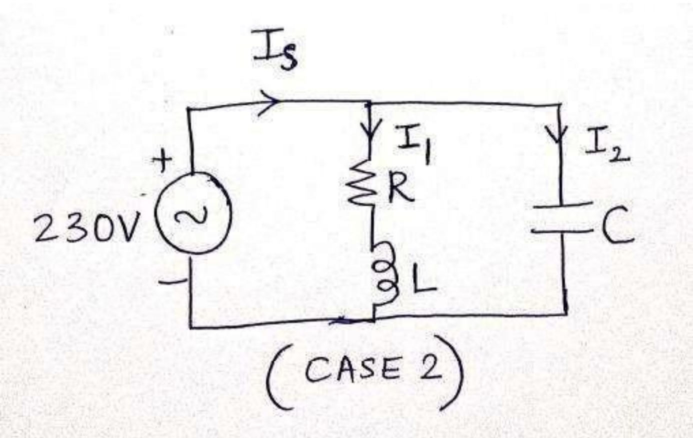
Case 1: **V** = 230L0° V

Given, P = 2.5KW = V*Ii*cos(<D) ----------- (1)

Since, Power factor= 0.71 lag, substituting in (1),

Ii= 15.31A & <D = cos^{-1}(0.71) = 44.76°

Hence, h = 15.31L-44.76° A



Case 2: New Power factor= cos(<D') = 0.866 Lag

P remains same since Capacitor does not consume power

Hence, P = 2.5KW = V*Is*cos(<D')---------(2)

Solving (2), Is= 12.55A & <D' = cos^{-1}(0.866) = 30°

Hence, Is= 12.55L-30° A

By KCL, Is= **h+ Iz;** Hence, **Iz=** 4.51L90° A

Hence, Xc = (230/4.51) = 510

So, C = 62.41μF

ALTERNATIVE SOLUTION:

Case 1: V = 230L0° V

Given, P = 2.5KW = V*Ii*cos(<D) ----------- (1)

Since, Power factor= 0.71 lag, substituting in (1),

Ii= 15.31A & <D = cos^{-1}(0.71) = 44.76°

Hence, h = 15.31L-44.76° A

Hence, $Y_1 = I_1/V = 0.0665\angle{-44.76°}$ S

Case 2: New Power factor= cos{<D') = 0.866 Lag

Yz = jBc & <D' = $\cos^{-1}$(0.866) = 30°

Yr= Y1+ Yz = 0.0665L-44.76° S + jBc

= 0.0472-j0.0468+ jBc

Angle in the admittance is negative of phase

angle i.e., $\tan^{-1}$ {{Bc-0.0468)/0.0472) = - 30°

Solving, Be= 0.0195 S =we; Hence, C = 62.22μF